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NET RAILWAY EARNINGS for the month of July and the first seven months of 1890, according to statistics collected by the *Financial Chronicle* are as follows:

	July. (126 roads.)		Jan. 1 to July 31. (119 roads.)	
	1890.	1889.	1890.	1889.
	$	$	$	$
Gross earnings....	55,142,677	52,232,395	339,412,625	307,700,987
Oper. expenses....	37,369,686	34,241,055	235,877,508	212,292,897
Net earnings....	17,772,991	18,011,340	103,535,117	95,408,090

It is seen from this that there has been a decrease in net earnings for the first time in many months. This poor showing is due largely to heavy decreases by a few of the large systems, the general condition of net earnings being better than the figures indicate. The principal cause for the decrease is a large increase in operating expenses amounting to over $3,000,000. It is also to be remembered that the result of operations for the month are being compared with a very favorable month last year.

THE PIKE'S PEAK RAILWAY (Abt system) is progressing rapidly to completion, in spite of some annoying delays. The first trial trip with a passenger car was made Aug. 14; on the next day the road was opened to the public as far as the Half Way House, with two trains daily; but these were stopped Sept. 1 for lack of sufficient patronage and because it impeded somewhat the work at the front. The cars are nearly all glass from window sill to roof, with very narrow pilasters between windows. The track is now well above the timber line, within about 1,000 ft. of the summit.

THE PIKE'S PEAK ENGINES gave at the beginning some trouble, principally on account of improper handling and poor coal, but now they do all that is required of them. They ran with a construction train weighing about 45,000 lbs., on 8% grades at 10 miles per hour, and on 25% grades at 4 to 5 miles per hour, their regulation speed. Down hill they ran uniformly at about 7 miles per hour. Two engines take up, as a rule, 4 loads daily, each consisting of 210 ft. of complete track, but there are some delays for lack of men (many cannot stand working at such altitude, and leave) so that surfacing is delayed. There are also but two engines as yet on the road, with consequent delays for repairs. Tracklaying commenced on June 10, and will not be finished before Oct. 5 (all going well), or about 100 working days for 46,000 ft., making an average of only 460 ft. a day. Apart from these delays some 800 ft. per day might be laid, as has frequently been done.

THE MALLET ARTICULATED COMPOUND LOCOMOTIVE, invented by A. MALLET, the French engineer, seems to have found favor in very different classes of service, judging from a print sent us by M. MALLET, showing the largest and smallest locomotives of this type ever constructed. The large machine is a 12-wheeled engine used on the St. Gothard Ry., and is named "Goliath." The smaller engine is one of the locomotives used on the Decauville narrow-gauge railways, and is appropriately named "Tom Thumb." It will be remembered that the Mallet locomotives have the weight all on the drivers, the front and rear trucks each being driven by a separate pair of cylinders. The two locomotives compare as follows in dimensions:

	Decauville.	St. Gothard
Weight of engine, light	20,200 lbs	143,000 lbs.
Max. when loaded	25,500 lbs.	187,000 lbs.
Length over all	17 ft. 7 ins.	46 ft.
Total wheel base	9 ft. 2½ ins.	27 ft. 7 ins.
Wheel base, each truck	2 ft. 9½ ins.	9 ft.
Gauge of track	4 ft. 9 ins.	1 ft. 11⅝ ins.
Capacity of tank	357 galls.	2,118 galls.
Diameter high pressure cylinder	7.28 ins.	15.5 ins.
Diameter low pressure cylinder	11.0 ins.	22.4 ins.
Stroke (same for high and low)	10.23 ins.	25.2 ins.
Diameter driving wheels	23.6 ins.	48.5 ins.
Grate surface	5.3 sq. ft.	23.1 sq. ft.
Heating surface	240 sq. ft.	1,702 sq. ft.

THE BLOCK SYSTEM has just been put in use on the Baltimore & Ohio between Wilmington and Philadelphia, 25 miles, in which distance 14 blocks have been established. Signal stations are also to be erected between Alexandria Junction and Washington, and between Relay station and Baltimore. The Michigan Central is to equip 14 miles of its line with the Hall system of block signals.

THE MOST SERIOUS ACCIDENT of the week, and by far the worst for many weeks, with the exception of the Old Colony disaster a month ago, occurred on the Philadelphia & Reading R. R., Sept. 19, near Shoemakersville, Pa., about 15 miles north of Reading. Two coal trains of 150 loaded cars each were running on the south-bound track about 12 minutes apart. The forward train broke in two, and the rear section was run into by the following train, throwing two loaded coal cars over on to the north-bound track. The crews of the wrecked trains, according to the testimony before the coroner's jury, did not send out signals immediately, as they should have done; and in a very short time a fast passenger train on the north-bound track dashed around the curve and ran into the wrecked cars. The train consisted of 7 cars, all of which were well filled, and is said to have been running at over 50 miles per hour. The force of the collision threw the engine from the track, and all but the two rear cars went down the embankment, the engine and forward cars going into the Schuylkill River, which is here 4 to 8 ft. deep. The total number killed outright was 21, and about 30 were injured. Fire started in one of the wrecked cars, presumably from coals shaken from the ash-pan, as it seems too early for stoves to be in use, but was put out. The wreck is probably the worst ever experienced on the Philadelphia & Reading, with the exception of the head collision at Camphill, July 17, 1856, in which 66 persons were killed and over 100 were injured. The daily press has generally commented upon this accident as unavoidable; but this is a most narrow view to take, since an efficient block system would have absolutely prevented the collision between the coal trains, and the break in two itself was the result of defective couplings. The Philadelphia & Reading has an enormous traffic over this line, much too large to be safely operated by any other than the block system. Simply because the bulk of it is freight traffic is not a valid reason for delaying the use of this system, as this fearful accident fully proves.

ANOTHER SERIOUS ACCIDENT, resulting in the death of 6 persons, occurrred on Sept. 21 in the suburbs of Chicago. A Chicago, Burlington & Quincy suburban train ran into the rear of an Illinois Central excursion train. The engineer claimed he could not see the tail lights on the rear car of the train ahead, but the real responsibility for the disaster seems to rest with the operator in the block signal station who let the two trains run into the same block. The block system has just been put in use here. If this be correct, the accident furnishes another illustration of the superiority of the automatic block over that operated by signalmen, similar to that given by the Meadows collision on the Pennsylvania R. R. some years ago.

AMONG OTHER SERIOUS COLLISIONS are one on the Mexican Ry., at Rinconada, Mex., Sept 19, a head collision between a work train and a freight train, killing 10 men; one on the Wabash, near St. Louis, Sept. 23, killing the engineer and injuring 25 passengers; one on the New York, Lake Erie & Western, near Middletown, N. Y., killing two men and injuring two; one on the Baltimore & Ohio, 12 miles from Connellsville, Pa., killing an engineer and injuring five others; and five others in various localities, which caused a total of 5 deaths and 7 injuries.

A TRESTLE ACCIDENT is reported near Sunny Side, No. Dak., on the Northern Pacific. A broken car wheel threw half a dozen loaded cattle cars into the ravine. A freight train on the Omaha & St. Louis Ry. went through a burning trestle 7 miles from Council Bluffs, Ia., Sept. 20, and 3 men were killed. A highway bridge at London, O., went down under a traction engine, Nov. 18.

DAM FAILURES have been numerous. The dam at the outlet of Bonesteel Pond, 12 miles east of Troy, N. Y., gave way Sept. 18, and the flood carried away buildings, dams, and bridges for several miles. On the same date a dam near the head of Broad Brook, in the town of Ellington, Ct., gave way, and the flood swept down the valley for 8 miles to the Connecticut River, carrying out 5 dams, 2 railway trestles and 6 highway bridges. The total loss is set at $50,000. Highway bridges have been carried away by floods in many parts of New York and New England.

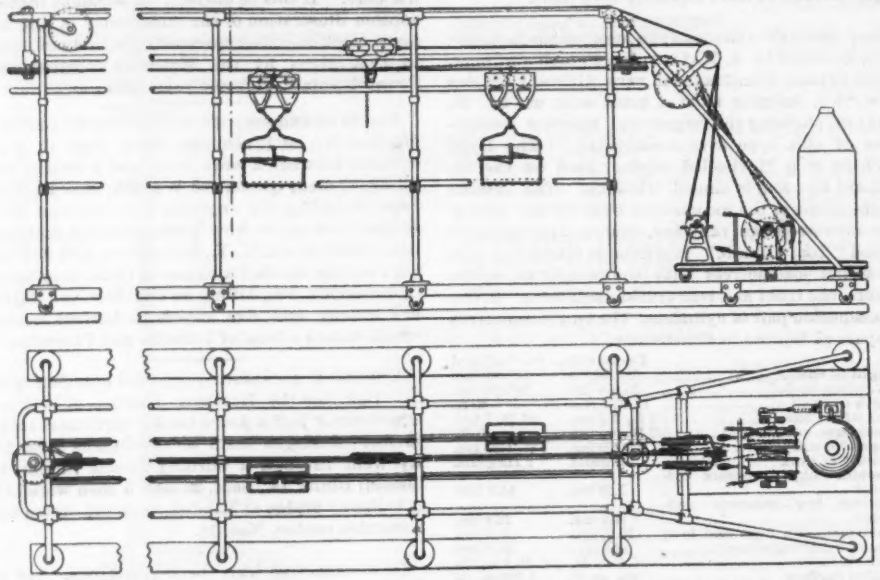
A WATER FAMINE is imminent in Toronto, according to the *Globe* of that city. The supply has been deficient for some time, and in 1889 contracts were let for increasing the capacity of the intake pipe, and replacing a wooden section of the pipe with steel. During this work it became necessary to drive some piles, and owing to a blunder by some one a pile was driven through the wooden section of the intake. This admitted sand to the pipe and pumps, and reduced the efficiency of the latter. The Rose Hill Reservoir, with a capacity of 40,000,000 galls., which receives the surplus water after it has been pumped through the distributing system, has finally been completely exhaused, and the water-supply is so limited that, for a time at least, the supply to hydraulic motors and for street sprinkling has been refused. With the completion of the improvements to the conduit a daily supply of 42,000,000 can be delivered to the pump-wells, but the pumps have a combined nominal capacity of but 22,000,000 imp. galls., and a working capacity at present considerably less. A by-law providing $200,000 for a new 10,000,000-gall. pumping engine will be submitted on Oct. 16. The reservoir has not been cleaned for 8 years, and upon being emptied it showed a rank growth of water plants, and "in some parts mud 4 ft. deep, in look and smell like sewage matter of the vilest kind." The reservoir is being cleaned.

THE RIVER AND HARBOR BILL was signed by the President on Sept. 19, and is now a law. Doubtless the most important provision of the bill is that appropriating $6,200,000 for securing a deep water harbor at Galveston, Tex., a measure for whose success the Southwest has been working most energetically. It will be remembered that this site for a deep water port on the Gulf was recommended by a board appointed from the U. S. Engineer corps some months ago. Other Southern harbors receive generous appropriations, among them Savannah and Charleston. At the former port work is to be commenced on improvements which are intended to secure a safe channel with 26 ft. of water from Savannah to the sea, at a total cost estimated at $6,000,000.

The expenditure of the many million dollars appropriated by the bill will certainly have a very marked effect in giving employment to engineers and contractors, especially the latter

A New Excavator for Sewer Trenches.

We illustrate herewith a new excavating machine recently designed by a Boston inventor. Under the system of excavation employed by this machine the material excavated is handled but once, and the operation is continuous, a line of loaded buckets passing out and a line of empty ones returning to be filled at the same time. Excavating machines in common use require the empty buckets to be returned over the same line over which the full ones are sent out, and it is claimed that for this reason the new machine can work more rapidly and cheaply.



FIGS. 1 AND 2. ELEVATION AND PLAN OF APPARATUS FOR HANDLING EXCAVATED MATERIALS.

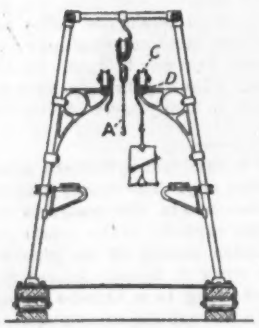
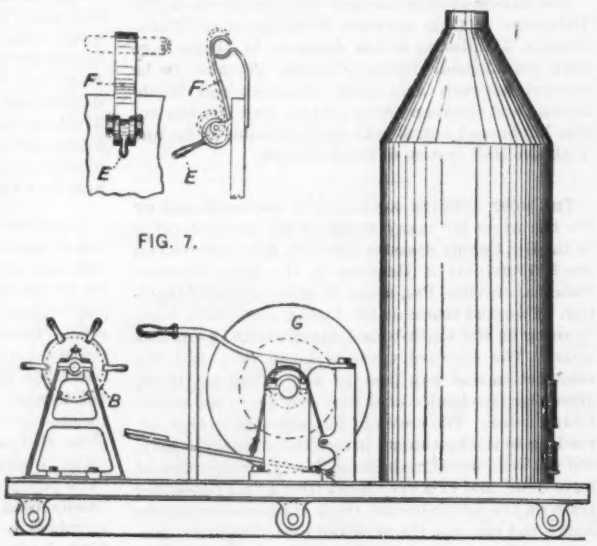


FIG 3. CROSS-SECTION OF APPARATUS.

FIG. 7.



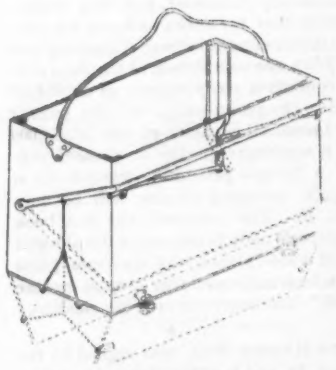
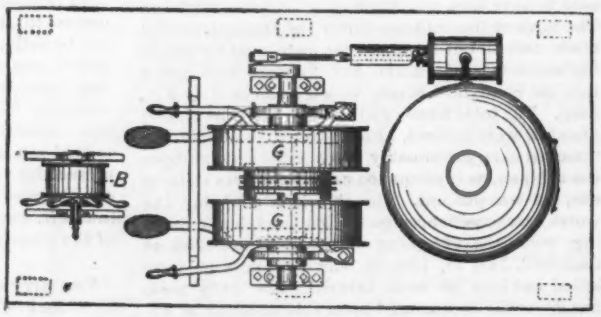


FIG. 4. BUCKET FOR HOLDING MATERIAL.



FIGS. 5 AND 6. PORTABLE ENGINE.

The new apparatus is shown in general elevation and plan by Figs. 1 and 2. It consists of a light wooden framework mounted on small wheels. These rest upon light I rails, by means of which the apparatus can be moved along to keep it up to the working face of the trench. Upon this framework is stretched an endless wire cable, running on sheaves on either side of the center line, as shown in the cross-section view, Fig. 3. The cable passes around sheaves at each end of the railway, and is driven by means of a chain passing around a drum upon the engine shaft. On one side of the frame-work the buckets are advancing and on the other returning, as shown.

The buckets are made with shutter bottoms and an automatic opening or unloading device, operating in a similar manner to those on dredge buckets. One of these buckets being filled in the trench, it is raised by hooking the handle to the chain *A*, Fig. 3, and operating the capstan *B*, Figs. 5 and 6. As soon as it is raised high enough, the handle is transferred to the hook of the carrier, *C*, which runs upon the cable *D*. By a single motion of a handle, *E*, Fig. 7, which is connected with an eccentric, a clamp *F* is brought firmly down upon the cable, which carries the loaded bucket to the point where the material is emptied and then returns it to the starting point.

The two drums, *G G*, shown in plan in Fig. 6, are loose upon the engine shaft, but clutches operated by a treadle will cause them to revolve with it. They are used for hoisting and lowering the buckets. But one drum is necessary, however, unless it is desired to operate two railways, one on either side of the engine.

Any further data in regard to the apparatus and its working can be obtained from F. E. GALLOUPE, M. E., 30 Kilby St., Boston.

Statistics showing the Progress and Prospects of Railway Construction in the Southwestern States.

(WITH MAP NO. 28.)

MISSOURI.—Existing Roads.

1. ***Cape Girardeau & Southwestern.***—Track laid in 1889, Williamsville to Hunter, 33 miles. Under survey, Cape Girardeau to New Madrid, 55 miles.

2. ***Chicago, Kansas City & Texas.***—Track laid in 1889, Kansas City to Smithville, 20.2 miles; Fair Grounds branch, 1.66 miles. Surveyed, Smithville to Gower, 16 miles.

3. ***Chicago, St. Paul & Kansas City.***—Leavenworth & St. Joseph Ry.—Under construction, St. Joseph to Leavenworth, Kan., 23 miles.

4. ***Cleveland, St. Louis & Kansas City.***—Track laid in 1889, in city of St. Charles, 0.5 miles; end track to Hamburg, 6 miles. Partly graded, St. Charles to Alton, 20 miles; Hamburg to Pinkney, 36 miles. Projected, Pinkney to Kansas City, 202.5 miles.

5. ***Greenfield & Northern.***—Partly graded, Greenfield to Stockton, 21 miles. President, L. W. Shafer, Greenfield.

6. ***Haines, Hamilton & Gulf.***—Under construction, Kingston to Hamilton, 8 miles. President, Chas. D. Haines; Chief Engineer, T. M. Long; both of Kingston.

7. ***Kansas City & Southern.***—Projected, Osceola to Bolivar, 49 miles.

8. ***Kansas City, Fort Scott & Memphis.***—Surveyed, Meriden to Carthage, 25 miles.

9. ***Kansas City, Fort Smith & Southern.***—Track laid in 1889, Neosho to Splitlog, 15 miles. Surveyed, Splitlog to Ft. Smith, Ark., 100 miles.

10. ***Kansas City, Nevada & Fort Smith.***—Graded, Kansas City to Amoret, 60 miles. Located, Amoret to Morett, 110 miles. President, E. L. Martin; Chief Engineer, F. W. Bond; both of Kansas City.

Kansas City Suburban Belt.—Track laid since Jan 1, 1890, Wyandotte St. to Blue River, 6.66 miles. Under construction, Blue River to Bush Creek, 6 miles. President, E. L. Martin; Chief Engineer, J. W. Heylman; both of Kansas City.

11. ***Mississippi River & Bonne Terre.***—Track laid in 1889, Silver Springs to Riverside, 25.2 miles.

12. ***Missouri Pacific.***—Fort Scott & Eastern Ry.—Track laid since Jan. 1, 1890, Fort Scott to Rich Hill, 27.22 miles. Projected, Rich Hill to Tipton, 100 miles.—Fort Scott & Southern Ry.—Under construction, Fort Scott to Minden, 27 miles. Under survey, Minden to Webb City, 23 miles. Under construction, Joplin to Empire mines, 5 miles. Located, Boonville to Jefferson, 46 miles. Under survey, Carthage to Batesville, Ark., 220 miles. Projected, Bagnel to Carthage, 125 miles.

Rockport, Langdon & Northern.—Track laid since Jan 1, 1890, Langdon northwest, 6 miles. Secretary, John D. Doff, Rockport.

13. ***St. Louis, Kinnett & Southern.***—Under construction, Campbell to Kinnett, 54 miles. Projected, Campbell to Poplar Springs, 25 miles.

Projects and Surveys.

14. ***Bellevue Valley.***—Projected, Iron Mountain to Schneider Quarries, 3.75 miles. Julius A. Schneider, L. A. Coquard, both of St Louis.

Joplin Belt Line.—Projected, belt line reaching mines in the vicinity of Joplin, 20 miles. President, S. C. Henderson; Vice-President, O. H. Picher; both of Joplin.

15. ***Kansas City & Excelsior Springs.***—Surveyed, Missouri City to Excelsior Springs, 8 miles. President, W. B. Johnson; Secretary, Jas. E. McColger, both of Excelsior Springs.

Kansas City Link.—Under contract, belt line at Kansas City, 27 miles. President, J. Seymour Scott; Chief Engineer, Wm. B. Knight, both of Kansas City.

16. ***Reed Springs & Kansas City.***—Surveyed, Liberty to Birmingham, 4 miles. Samuel Hardwicke, Liberty.

17. ***St. Joseph & Excelsior Springs.***—Projected, St. Joseph to Camden, 60 miles.

Total.—Track laid in 1889, 101.56 miles. Track laid since Jan. 1, 1890, 39.88 miles. In process of construction, 268 miles. Surveyed or under survey, 397 miles. Projects of some promise, 625 miles.

KANSAS.—Existing Roads.

18. ***Atchison, Topeka & Santa Fe.***—Projected, Mullinsville to Dodge City, 30 miles.

19. ***Dodge City, Montezuma & Trinidad.***—Projected, Montezuma to Trinidad, 217 miles.

20. ***Kansas City, Wyandotte & Northwestern.***—Track in 1889. Axtel to Summerfield, 12 miles. Projected, Carbondale to Wichita, 125 miles.

21. ***Marion Belt & Chingawassa Springs.***—Track laid in 1889, Marion to Chingawassa, 5 miles; Marion to Duree, 3 miles.

12 ***Missouri Pacific.***—Track laid in 1889. Coffeyville to Indian Territory line, 2.2 miles.—Ft. Scott Belt & Terminal Ry.—Under construction, belt line at Ft. Scott, 5 miles.

22. ***Omaha, Hutchinson & Gulf.***—Track laid in 1889, Hutchinson to Kingman, 31 miles. Track laid since Jan. 1, 1890, Kingman to Indian Territory line, 50.01 miles. Projected Kansas State line to Texas State line, 250 miles President, Wm. E. Hutchinson, Hutchinson, Chief Engineer, H. L. Jackson, Kingman.

23. ***Topeka, Westmoreland & Marysville.***—Track laid in 1889, Topeka west, 5.5 miles. Under construction, To-

peka north, 55 miles. Surveyed, 55 mile post to Odell, Neb., 55 miles.

Projects and Surveys.

24. ***Chicago, Kansas & Nebraska.***—Surveyed, St. Joseph to Oskaloosa, 50 miles. Projected, Oskaloosa to Joplin, 200 miles. President, Jas. Hansen; Chief Engineer, Frank Fanning; Treasurer, Fred. Parker; all of St. Joseph, Mo.

25. ***Highland & St. Joseph.***—Projected, Highland to Ryan's Station, 5 miles. Chas. D. Haines, Z. L. Gilmore, Highland.

26. ***Kansas City, Lawrence & Nebraska.***—Projected, Lawrence to Grand Isle, Neb., 375 miles. President, W. N. Chick, Kansas City; secretary, Jas. M. Jewett, Lawrence.

27. ***Omaha, Garden City, & Southwestern.***—Projected, Ness City to Garden City, 70 miles. C. E. Gallegher, Dodge City; Jas. A. Patton, Garden City.

Total.—Track laid in 1889, 58.7 miles. Track laid since Jan. 1, 1890, 50.01 miles. In process of construction, 85 miles. Surveyed or under survey, 101 miles. Projects of some promise, 742 miles.

INDIAN TERRITORY.—Existing Roads.

18. ***Atchison, Topeka & Santa Fe.***—Track laid since Jan. 1, 1890, Ardmore to coal mines, 4.5 miles.

28. ***Chicago, Rock Island & Pacific.***—Track laid in 1889, Pond Creek to Okarche, 68.8 miles. Track laid since Jan. 1, 1890, Okarche to Minco, 29.5 miles. Surveyed, Minco to Red River, 100 miles.

29. ***Choctaw Coal & Railway Co.***—Track laid in 1889, McAlester east, 16.58 miles. Track laid since Jan. 1, 1890, end of track to Wister, 48.11 miles. Under construction, McAlester to Ft. Reno, 150 miles. Surveyed, branch to Denison, Tex., 115 miles. Projected, Wister to Little Rock, Ark., 137 miles; Ft. Reno to Texas State line, 120 miles.

Denison & Washita Valley.—Track laid in 1889, Wetmore to Coal Gate, 9 miles.

12. ***Missouri Pacific.***—Track laid in 1889, Kansas State line to Wagoner, 79.3 miles.

Projects and Surveys.

30. ***Guthrie, Reno City & Ft. Reno.***—Surveyed, Guthrie to Ft. Reno, 41 miles. President, O. Jennings, Anthony, Kan.; Chief Engineer, C. J. Du Bois, Reno City; Vice-President, J. W. McNeal, Guthrie.

31. ***Paris, Choctaw & Little Rock.***—Projected, Paris to Arkansas State line, 80 miles.

Total.—Track laid in 1889, 163.68 miles. Track laid since Jan. 1, 1890, 82.11 miles. In process of construction, 150 miles. Surveyed or under survey, 256 miles. Projects of some promise, 447 miles.

ARKANSAS.—Existing Roads.

32. ***Arkansas Midland.***—Projected, main line to Indian Bay, 15 miles; main line to Old Town, 20 miles.

33. ***Batesville & Brinkley.***—Track laid in 1889, Cache River to Gregory, 3 miles. Surveyed, Batesville to Jacksonport, 22 miles. Projected, Brinkley to Helena, 43 miles; Newport to Missouri State line, 75 miles.

34. ***Brinkley, Helena & Indian Bay.***—Track laid. Glenwood to Pine City, 16 miles.

35. ***Camden & Alexandria.***—Located, Camden to Eldorado, 32 miles. Projected, Eldorado to Alexandria, 143 miles.

36. ***Eureka Springs.***—Surveyed, Eureka Springs to Harrison, 49.5 miles.

37. ***Ft. Smith, Paris & Dardanelle.***—Projected, end of track to Dardanelle, 75 miles.

38 ***Kansas City, Arkansas & New Orleans.***—Partly graded, Stuttgart south 35 miles. Surveyed, Stuttgart to Beebe, 45 miles; end of grade to Monroe, La., 120 miles main line to Pine Bluff, 20 miles. President, Geo. M. Barbour, Beebe, Ark.

39. ***Louisiana, Arkansas & Missouri.***—Under construction, Tripp to Delhi, 80 miles. Projected, Tripp to Brinkley, 100 miles; Delhi, La., to Alexandria, La., 100 miles. President, Harlow M. Hoyt, 58 William St., New York City; Chief Engineer, W. C. Agnew, Youngstown, O.

40. ***Louisville, New Orleans & Texas.***—Helena Transfer.—Track laid since Jan. 1, 1890, 9 miles.

41. ***Mississippi & Little Rock.***—Track laid since Jan. 1, 1890, between Duncan and Little Rock, 20 miles. Graded, between Duncan and Little Rock, 41 miles.

42. ***St. Louis, Iron Mountain & Southern.***—Under survey, Warren to Camden, 45 miles.

43. ***Stuttgart & Arkansas River.***—Track laid since Jan. 1, 1890, Stuttgart to Dewitt, 25 miles. Under construction, Dewitt to Pendleton, 20 miles.

44. ***Texarkana & Ft. Smith.***—Under construction, Red River north, 25 miles.

Projects and Surveys.

45. ***Arkansas & Gulf.***—Surveyed, Pendleton to Louisiana State line, 85 miles. President, W. R. Bergholz, 15 Cortlandt St., New York City.

46. ***Beebe, Des Arc & Brinkley.***—Projected, Beebe to Brinkley, 50 miles. General Manager, F. P. Laws, Beebe.

47. ***Camden, Louisiana & Sabine Pass.***—Projected, Camden to Louisiana State line, 50 miles. President, Asa S. Morgan; Chief Engineer, J. Victor Pedron; both of Camden.

48. ***Hackett City, Greenwood & Eastern.***—Projected, Greenwood east to coal lands, 20 miles. President, Robert H. McConnell; Chief Engineer, Jas. E. Johnson; both of Greenwood.

Little Rock Belt.—Surveyed, belt line at Little Rock, 20 miles. President, S. C. Martin; Chief Engineer, F. S. Ingoldsby; both of Little Rock.

49. ***Kearney & Sheridan.***—Under survey, Kearney to Sheridan, 15 miles. Chief Engineer, J. J. Martin, Pine Bluffs.

50. ***Memphis, Arkansas & Texas.***—Surveyed, Memphis, Tenn., to Marianna, 50 miles. President, Geo. Arnold; Chief Engineer, T. I. Dabney; both of Memphis.

51. ***Memphis, Little Rock & Indian Territory.***—Projected, Little Rock to Indian Territory line, 144 miles. President, G. A. I. Milair; Chief Engineer, H. A. Schwanecke; both of Little Rock.

52. ***Southern Arkansas.***—Surveyed, Dry Run to Hampton, 23 miles. President, John Bugley, Box 483, Chicago, Ill.; Chief Engineer, John Brantley, Dry Run; T. F. Doyle, Dry Run.

53. ***Tennessee, Arkansas & Texas.***—Projected, Little Rock to Indian Territory line, 120 miles.

Total.—Track laid in 1889, 19 miles. Track laid since Jan. 1, 1890, 99.35 miles. In process of construction, 163 miles. Surveyed or under survey, 716 miles. Projects of some promise, 944 miles.

LOUISIANA.—Existing Roads.

54. ***Kansas City, Watkins & Gulf.***—Track laid since Jan. 1, 1890, Lake Charles north, 15 miles. Graded, end of track to Alexandria, 90 miles. President, J. B. Watkins, Lawrence, Kan.; Chief Engineer, P. H. Philbrick, Lake Charles.

55. ***Louisiana & Northwest.***—Track laid in 1889, Gibiland to Bienville, 15 miles. Surveyed, Bienville to Alexandria, 90 miles. Projected, Homer to Hope, Ark., 60 miles.

40. ***Louisville, New Orleans & Texas.***—Track laid in 1889, Slaughter to Bayou Sara, 16.4 miles.

12. ***Missouri Pacific.***—Houston, Central Arkansas & Northern R. R.—Track laid in 1889, Columbia to Mer Rogue, 58 miles. Track laid since Jan. 1, 1890, McGehee, Ark., to Mer Rogue, 65.35 miles. Under construction, Riverton to Alexandria, 75 miles.

56. ***Natchitoches.***—Projected, Natchitoches to Red River, 15 miles.

57. ***New Orleans & Northwestern.***—Track laid in 1889, Vidalia to Tensas River, 16 miles. Track laid since Jan. 1, 1890, Tensas River to Rayville, 58.25 miles. Under construction, Rayville to Bastrop, 25 miles. Under survey, Bastrop to Arkansas State line, 16 miles. Projected, Louisiana State line to Hamburg, 20 miles.

New Orleans, Ft. Jackson & Grand Isle.—Track laid in 1889, New Orleans south, 7 miles. Track laid since Jan. 1, 1890, end of track south, 20 miles. Under construction, end of track to Ft. Jackson, 38 miles. Surveyed, branch to Grand Isle, 25 miles.

Texas Pacific.—Track laid in 1889, Plaquemine to Indian Village, 7.26 miles.

Projects and Surveys.

Bayou Lafourche Central.—Projected, St. James to Lake Verret, 20 miles. President, Jas. Mahle, 166 Common St., New Orleans.

58. ***Gulf, Sabine & Kansas City.***—Projected, Shreveport to Sabine Pass, 180 miles. Thos. Doak, Ft. Smith, Ark.; Horace A. Keefer, Kansas City.

59. ***Kansas City, Louisiana & Gulf.***—Located, Arcadia to Boyce, 37 miles. Projected, Boyce to Vermillion Bay, 110 miles. Chief Engineer, Jos. J. Waitz, Atchison, Kan.

New Orleans Belt.—Projected, belt line at New Orleans, 17 miles.

Total.—Track laid in 1889, 119.66 miles. Track laid since Jan. 1, 1890, 113.25 miles. In process of construction, 266 miles. Surveyed or under survey, 308 miles. Projects of some promise, 845 miles.

TEXAS.—Existing Roads.

Austin & Northwestern.—Track laid in 1889, Burnet to Marble Falls, 16 miles. Projected, Marble Falls to Llano, 15 miles.

Corpus Christi & South American.—Under construction, Corpus Christi to Brownsville, 150 miles. President, E. H. Ropes; Chief Engineer, D. J. Thayar; S. H. Mallory; all of Corpus Christi.

60. ***Dallas, Pacific & Southeastern.***—Partly graded, Dallas, northwest, 65 miles. Chief Engineer, W. J. Sherman, Dallas.

61. ***Denison, Bonham & New Orleans.***—Under construction, Denison to Bonham, 28 miles. Under survey, Denison to Sherman, 9 miles.

Denison Rapid Transit.—Track laid in 1889, in Denison, 6.1 miles.

62. ***Ft. Worth & Albuquerque.***—Partially graded, Ft. Worth to Springtown, 30 miles. Projected, Springtown to Graham, 45 miles. President, Charles C. Black, Ft. Worth.

63. ***Ft. Worth & Rio Grande.***—Track laid in 1889, Granbury to Dublin, 49.7 miles. Track laid since Jan. 1, 1890, Dublin to Comanche, 22 miles. Under construction, Comanche to Brownwood, 25 miles. Surveyed, Brownwood to Brady, 50 miles. Projected, Brady to Kerrville, 112 miles.

64. ***Gulf, Brazos Valley & Pacific.***—Under construction, Milsaps to Mineral Wells, 10 miles. Surveyed, Mineral Wells to Henrietta, 70 miles. Projected, Milsaps to Velasco, 320 miles. President, C. W. White; Chief Engineer, G. B. Gurley; both of Waco.

Haines Medina Valley.—Track laid since Jan. 1, 1890, Castroville to Lacoste, 7 miles. President, Mrs. Chas. D. Haines; Chief Engineer, Owen Merriwether; both of Castroville.

Houston Belt & Magnolia Park.—Under construction, Houston to Port Houston, 4 miles. President, J. T. Brady, Houston.

65. ***Houston & Texas Central.***—Track laid since Jan. 1, 1890, Hutchins to Lancaster, 5 miles.

66. ***Missouri, Kansas & Texas.***—Track laid in 1889, Lancaster to Waxahachie, 16 miles. Partly graded, Waxahachie to Hillsboro, 36 miles; Smithville to Lockhart, 36 miles; Boggy Tank to Sealy, 27 miles.

67. ***Paris, Marshall & Sabine Pass.***—Projected, Montvale to Paris, 100 miles.

68. ***Red River, Sabine & Western.***—Surveyed, Ft. Worth to San Augustine, 200 miles. Partly graded, Nacogdoches east, 10 miles. Projected, San Augustine to Alexandria, 105 miles. President, L. W. Lloyd, Nacogdoches.

69 ***San Antonio & Aransas Pass.***—Track laid in 1889, West Point north, 25 miles; Waco south, 18 miles; Brazos River east, 20 miles; Shiner to Lockhart, 55.5 miles. Track laid since Jan. 1, 1890, end of track north of West Point, north 35 miles; end of track south of Waco, south 10 miles. Under construction, between ends of track, 32 miles. Surveyed, Houston to Alexandria, La., 220 miles Projected, Waco to Paris, 200 miles; Kennedy to Laredo, 150 miles.

70. ***Sherman, Denison & Dallas.***—Track laid since Jan. 1, 1890, Sherman to Denison, 10 miles. Surveyed, Sherman to Dallas, 80 miles. President, C. H. Osburn, Ft. Scott, Kan., Chief Engineer, Geo. M. Harvis, Denison.

Southern Pacific.—Track laid in 1889, Victoria to Beeville, 55 miles.

Texarkana Northern.—Track laid in 1889, Texarkana to Arkansas State line, 1 mile.

71. ***Weatherford, Mineral Wells & Northwestern.***—Under construction, Weatherford to Mineral Wells, 18 miles.

72. ***Wichita Valley.***—Track laid since Jan. 1, 1890, Wichita Falls to Seymour, 51 miles. President, Morgan Jones, Fort Worth; Chief Engineer, P. H. McCrickett, Wichita Falls.

73. ***Yellow Pine Lumber.***—Track laid in 1889, Colmsneil to Neches River, 12 miles. Projected, Neches River to Alexandria, 124 miles. General Manager, M. N. Carson, Colmsneil.

Projects and Surveys.

74. ***Abilene & San Angelo.***—Projected, Abilene to San Angelo, 75 miles.

75. ***Anson & Abilene.***—Projected, Anson to Abilene, 28 miles. H. C. McEachen, Anson.

Brackett, Ft. Clark & Rio Grande.—Surveyed, Brackett to Spofford Junction, 5 miles. B. H. Gardner, Brackett.

76. ***Bridgeport & Decatur.***—Surveyed, Decatur to Bridgeport, 11 miles. President, J. J. Lang, Decatur; Chief Engineer, Wm. Bradium, Marshall.

Brownsville, Continental & Northern.—Projected, Brownsville to San Antonio, 300 miles. President, Feliciano San Romano; Vice-President, Jas. G. Brown; both of Brownsville.

76½. ***Corsicana & Southeastern.***—Surveyed, Corsicana to International & Great Northern Ry., 50 miles. President, Chas. H. Allyn, Corsicana.

Lampasas, Burnet & Southern.—Surveyed, Lampasas to Llano, 58 miles. Chief Engineer, H. L. Higdon, Lampasas.

Navasota & Huntsville.—Surveyed, Navasota to Huntsville, 42 miles. D. C. Geddings, Brenham.

Aransas Pass & Harbor City.—Under survey, Rockport to Victoria, 60 miles.

77. ***Sherman & Northwestern.***—Surveyed, Sherman to Ardmore, 53.5 miles. W. A. Thomas, Sherman.

78. ***Texas, Sabine Valley & Northwestern.***—Projected, Carthage to Logansport, 25 miles. R. J. Evans, Longview.

Total.—Track laid in 1889, 274.3 miles. Track laid since Jan. 1, 1890, 140 miles. In process of construction, 475 miles. Surveyed or under survey, 828 miles. Projects of some promises, 1,450 miles.

ILLINOIS.—Existing Roads.

(*Lines within limits of map only.*)

Alton Terminal.—Track laid in 1889, in city of Alton 1.5 miles.

79. ***Centralia & Chester.***—Track laid in 1889, Sparta to Coulterville, 8.5 miles. Graded, Centralia to Coulterville, 33 miles. Projected, Centralia to Altamont, 45 miles; Sparta to Chester, 20 miles.

80. ***Chicago & Ohio River.***—Projected, Olney to Paducah, 130 miles.

81. ***Chicago, Peoria & St. Louis.***—Track laid in 1890, Litchfield to Edwardsville, 26 miles. Under construction, Edwardsville to East St. Louis, 22 miles.

82. ***Grand Tower & East Cape Girardeau.***—Track laid in 1889, Grand Tower to East Cape Girardeau, 28 miles.

83. ***Indiana & Illinois Southern.***—Projected, 12 miles west of Newton to East St. Louis, 115 miles.

84. ***Louisville, Evansville & St. Louis.***—Track laid in 1889, Mt. Vernon to Walnut Hill, 16 miles. Track laid since Jan. 1, 1890, Centralia to Belleville, 48.9 miles.

85. ***North & South Ry. of Illinois.***—Projected, Alhambra to East St. Louis, 28 miles.

86. ***St. Louis, Alton & Springfield.***—Track laid in 1889, Newbern to Alton, 14 miles. Surveyed, Alton to Venice, 20 miles.

85. ***St. Louis & Chicago.***—Track laid in 1889, Mt. Olive to Alhambra, 14 miles.

87. ***St. Louis, Chester & Birmingham.***—Under contract, East St. Louis to Grand Tower, 90 miles.

Projects and Surveys.

88. ***Belleville & St. Louis.***—Under survey, Belleville to East St. Louis, 8 miles. President, John S. Hill, East St. Louis; Edward L. Thomas, Belleville.

89. ***Cairo & Northwestern.***—Projected, Cairo to East Cape Girardeau, 40 miles. President, Chas. O. Patiee; Chief Engineer, Geo. W. Morse, both of Cairo.

90. ***Little Wabash.***—Projected, Effingham to Carmi, 75 miles. President, J. J. McCawley, Clay City; Vice-President, Edward Austin, Effingham.

91. ***St. Louis, Venice & Alton.***—Surveyed, Alton to East St. Louis, 20 miles. H. M. Needles, Belleville.

Total.—Track laid in 1889, 82 miles. Track laid since Jan. 1, 1890, 74.9 miles. In process of construction, 145 miles. Surveyed or under survey, 48 miles. Projects of some promise, 453 miles.

MISSISSIPPI.—Existing Roads.

92. ***Georgia Pacific.***—Track laid in 1889, west of Columbus west, 103 miles. Track laid since Jan. 1, 1890, Itta Bena to Hopson's Bayou, 35 miles. Surveyed, Hopson's Bayou to Helena, Ark., 45 miles; Itta Bena to Yazoo City, 45 miles.

93. ***Gulf & Ship Island.***—Track laid in 1889, Bayou Bernard north 5 miles. Projected, end of track to Hattiesburg, 54 miles.

94. ***Kansas City, Memphis & Birmingham.***—Projected, Aberdeen to Columbus, 28 miles.

40. ***Louisville, New Orleans & Texas.***—Track laid in 1889, Riverside Junction to Hampton, 10.2 miles; Rosedale to Coahoma, 503 miles. Track laid since Jan. 1, 1890, Clarksdale to Minter City, 39 miles. Located, Minter City to Yazoo City, 66 miles.

95. ***Memphis & Atlantic.***—Under construction, West Point to Houston, 30 miles. Surveyed, Houston to Memphis, Tenn., 110 miles. President, F. M. Abbott; Chief Engineer, Belton Mickle, both of West Point.

96. ***Poplar Springs, Handley's Lake & Meridian.***—Track laid since Jan. 1, 1890, Meridian to Poplar Springs, 2.5 miles. Chief Engineer, M. N. Brandon, Meridian.

Projects and Surveys.

97. ***Columbus & Fulton.***—Surveyed, Aberdeen to Fulton, 30 miles.

98. ***Helena, Tupelo & Decatur.***—Projected, Tupelo to Decatur, 100 miles. Secretary, Harvey C. Medford, Tupelo.

99. ***Meridian & Tuscahoma.***—Projected, Meridian to Tuscahoma, Ala., 45.7 miles. President, W. H. Hardy, Meridian.

100. ***Mississippi Central Valley.***—Surveyed, Rosedale to Bayou Phalia River, 6.5 miles. President, Chas. Scott; Chief Engineer, R. B. Eggleson, both of Rosedale.

101. ***Mobile, Jackson & Kansas City.***—Located, Mobile to Brandon, 184 miles. President, H. Aust'll; Chief Engineer, T. W. Nicol; both of Mobile, Ala.

102. ***South Mississippi.***—Projected, Natchez to Meridian, 180 miles. President, J. S. Salomon, Meridian.

103. ***Tombigbee.***—Projected, Columbus to Decatur, 125 miles. Chief Engineer, A. C. Dancy. General Manager, C. E. Rodenburg; both of Columbus.

104. ***Waynesboro, Pascagoula & Gulf Coast.***—Projected, Waynesboro to Pascagoula, 107 miles. President, J. R. S. Pitts, Waynesboro.

Total.—Track laid in 1889, 168.5 miles. Track laid since Jan. 1, 1890, 77.5 miles. In process of construction, 29 miles. Surveyed or under survey, 461.5 miles. Projects of some promise, 434 miles.

A New Air Valve for Air Compressors.

The Ingersoll-Sergeant Manufacturing Co. has recently placed on the market air compressors fitted with an air valve, illustrated herewith, which is

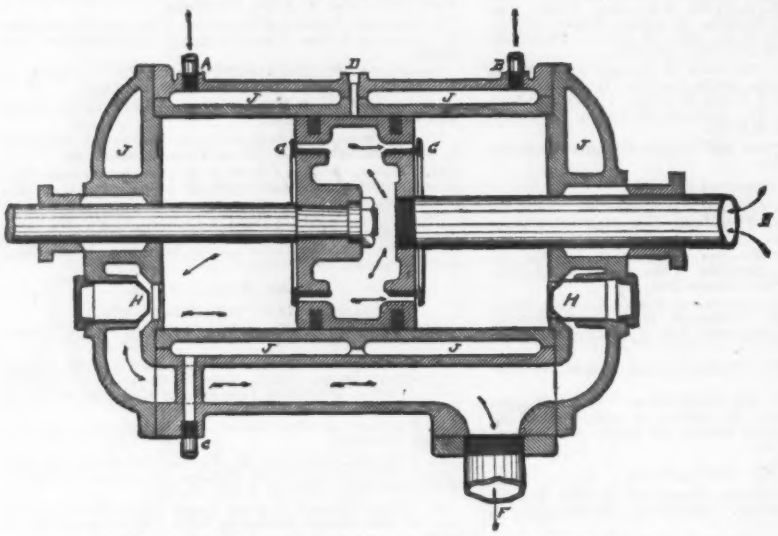


FIG. 1.—PISTON INLET-VALVE FOR AIR COMPRESSORS.

Ingersoll-Sergeant Rock Drill Co.

quite a new departure in its design, and has thus far operated with great satisfaction.

In the design of an air inlet valve for an air compressor it is desirable that the valve shall open without resistance at the very beginning of the stroke, and allow the air to flow unimpeded into the cylinders until the piston arrives at the opposite end of the cylinder. The valve should then close quickly, but without shock. The most common type of inlet valve is a simple poppet valve held to its seat by a light spring. When the piston moves it tends to create a vacuum in one end of the cylinder, and the atmospheric pressure, working against the spring, forces open the valve. Thus the pressure on the rear side of the piston, where spring actuated valves are used, is always somewhat less than the atmospheric. This causes both loss of power and reduction of capacity of the compressor.

Fig. 2.—Perspective View of Piston Inlet-Valve.

But a more serious fault of the spring actuated valves is the rapid wear of the valves and valve seats due to the concussion and chattering with which the valve closes. It occasionally happens that the wear and pounding become so serious that the valve or some portion of it breaks and is drawn into the cylinder, wrecking the piston, of course, at the next stroke.

A cylinder and piston fitted with the new air valve of the Ingersoll-Sergeant Rock Drill Co., is shown in the accompanying engraving, Fig. 1, and the valve itself is shown in Fig. 2. It will be seen that the piston is hollow with an annular port in each face. The interior of the piston is open to the external air by means of the hollow tail-end of the piston rod. The two valves, one on the front and the other on the rear face of the cylinder are duplicates. They are opened and shut simply by their own momentum and the current of air through the ports. As the port is of so large area, and is one continuous opening, the lift of the valve from its seat is very small. The manner in which this lift is controlled may be seen by reference to the perspective view of the valve, Fig. 2.

As there shown, each valve has 6 guide ribs upon it, and in each one of these is a slot through each of which passes a pin on the piston. When the piston starts to move at the beginning of the stroke the valve on the side where air is to enter remains behind by reason of its inertia, until the piston has moved a distance equal to the lift of the valve. The pins then strike the end of the slot and the valve is moved with the piston to the end of the stroke. Here as the piston halts, the inertia of the valve promptly brings it to its seat, and the return stroke immediately commences.

When this valve was first designed it was apprehended that the concussion of the pins against the end of the slots might cause some wear and breakage. Several months' trial, however, have shown that this does not take place. The piston is moving at so slow a speed at the time when the pins strike the end of the slots in the valve that the latter takes up its motion without shock. As for the valve seat itself, the very large area, as well as the low velocity with which the valve comes to its seat, combine to almost wholly prevent wear. At the same time the area of port opening is so large that even at the highest speeds the throttling of the entering air in the passages is imperceptible.

The use of this valve, moreover, permits each cylinder head to be water jacketed instead of the circumference of the cylinder only. This is especially important, as the cooling continues up to the very end of the stroke where the air is hottest, and where the cylinder walls afford a very small area for cooling, while the head affords a very large area. With circumferential cooling alone, only a narrow ring of cool metal is in contact with the air after it becomes heated to the maximum temperature.

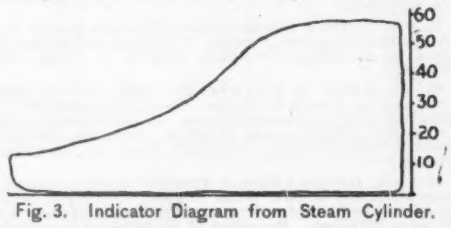


Fig. 3. Indicator Diagram from Steam Cylinder.

Boiler pressure, 58 lbs.; stroke, 18 ins.; cut-off, 3-10ths; revs., 40 per minute; M. E. P., 36.4 lbs.; I. HP., 26.61.

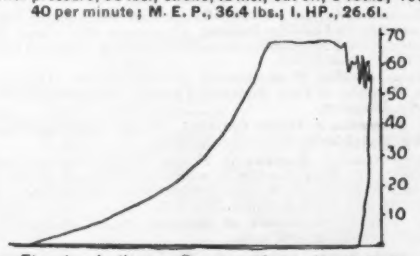


Fig. 4. Indicator Diagram from Air Cylinder.

Pressure in receiver, 70 lbs.; stroke, 18 ins.; revs., 40 per minute; initial temperature, 75 degs. (?); final temperature, 290 degs.; M. E. P., 33.2 lbs.; I. HP., 25.03 lbs.; power consumed in air cylinder equal to 94 per cent. of power generated in steam cylinder.

In reducing the clearance space to a minimum, and so increasing the economy of the compressor, the advantages of this valve are very marked. No holes are made in the cylinder heads for the inlet valves, but a single annular recess is turned in the head, which the projecting ring valve on the piston just fills. While the friction of the stuffing box at the rear end of the cylinder, through which the hollow tail-end rod passes, may be considered an objection, it is believed that this is fully compensated for in the reduced wear on the lower half of the cylinder and the more perfect guiding of the piston in a straight path.

By fitting a tube over the hollow piston rod, which may easily be done, and leading it outside, the air may be taken from a cool dry place, thus increasing the economy of the compressor. This, of course, may and always should be done with any compressor, yet it is not at all uncommon to see the inlet valves taking air directly from the compressor room where it is at a temperature of 80° or more.

In Figs. 3 and 4 indicator diagrams from a compressor fitted with this valve are shown, one card being from the steam cylinder and the other from the air cylinder. Measurements of the cards show that the steam cylinder developed 26.61 I. HP., and the air cylinder absorbed 25.03 I. HP. Thus the loss in friction of the machine was only 6%.

The air was compressed to 70 lbs. and entered the receiver at a temperature of 290°. This was an increase of about 215° over its temperature on entering. The theoretical increase of temperature where no cooling takes place in compressing to 70 lbs. is about 297°, or 372° temperature in all.

This shows, of course, a very considerable loss of power due to imperfect cooling; but cooling by a water jacket must inevitably be very imperfect compared with that secured by injecting water into the cylinder. Makers of air compressors, however, have generally abandoned the injection of water into the air cylinders, since the fuel economy which can undoubtedly be gained thereby is purchased at the risk of injury to the compressor cylinder by the use of dirty or acid water.

Thus for ordinary use in contractors' plant, mining work, etc., it is doubtless good policy to discard the internal cooling system; but engineers who may calculate on the possible economy in the transmission of considerable amounts of power by compressed air, should remember that where an abundance of clean water can be secured a very considerable increase over the usual economy can thereby be obtained.

The Nile Barrage.

The barrage or dam recently built at the head of the Nile delta will probably prove to be one of the most important public works in Egypt. Interesting details of construction have also arisen during the work, which has just been completed. From quite a full description in the London *Architect*, we abstract as follows:

The Nile barrage consists of 2 dams or weirs placed across the river at the point where it divides into 2 branches, one flowing into the sea at Rosetta and the other at Damietta. Each weir is a long bridge, the arches of which can be closed by gates when required, so as to hold the water back, and provided at the sides with locks for the passage of boats. During the dry season, the arches are closed and the water above the barrage is raised and diverted into 3 main channels, which irrigate the whole of Lower Egypt. When the river is in flood, the arches are opened and every possible obstruction to the flow of the stream is removed.

The work was begin in 1843 under the direction of MOUGEL Bey, a French engineer, and it was finished in 1861. The Rosetta weir had 61 arches, and was 1,525 ft. long, while the Damietta weir, with a length of 1,755 ft., was constructed with 71 arches. The total cost of the work was $8,712,000, a sum which does not take into account the enormous amount of forced labor employed on its construction. The Rosetta weir was fitted with gates, and was first tried in 1863. Cracks soon appeared, and a serious subsidence occurred in 1867, after which date any attempt to make use of the structure was abandoned. During this time the maximum height of water held back was 5 ft. 9 ins., and that was only for a short time. The Damietta weir was never supplied with gates.

In 1883, Sir COLIN MONCRIEFF, Under Secretary of State for Public Works, decided to rebuild and enlarge the barrage. During 1884 and 1885 the worst portions of the weirs were patched up at a cost of $213,500, and an attempt made to retain the water during the dry season. In the first year, the level was raised 7 ft. 2 ins., and in the second year 9 ft. 10 ins. This permitted the flushing of the

canals, and caused a very considerable increase of irrigation in Lower Egypt.

When, in 1885, the Great Powers gave their consent to an appropriation of $4,850,000 for irrigating, the first work undertaken was the repair of the barrage. The ground upon which the foundations are laid consists of nothing more solid than alternate beds of fine river sand and alluvial mud. During the dry season, while the arches are closed, there is a difference of level in the water on either side of nearly 10 ft. Hence the water has a constant tendency to percolate under the foundations and ultimately undermine them. In order to prevent this, the foundations were made very broad. A solid bed of Portland cement concrete, 4 ft. thick, was spread over the whole of the old flooring, and was covered under the arches and on the down stream side with a heavy pavement of dressed Trieste stone, and up stream, with rubble limestone masonry. A line of sheet piling, 16 ft. deep, was carried across the whole river 85 ft. above the bridge.

The preliminary work was begun on March 24, 1886. An earthen cofferdam was built out into the river enclosing the 20 arches at the western end of the Rosetta barrage, which were the arches most seriously cracked. The water within this dam was pumped out, and it was then possible to examine and repair the old foundation. The work done in this first short season was more or less of an experimental character, and there was only time to partially repair 6 bad floorings. Work began in earnest in 1887, when it was resolved to complete the western half of the Rosetta barrage. One of the chief difficulties that had to be encountered was that the working season was necessarily a very short one. On account of the state of the river flood a beginning could never be made before the end of November. The portion of the barrage which was to be operated upon was first enclosed by great earthen banks forming a cofferdam all round. They had to be made in deep water, and this part of the work always took more than two months. Then the water inside had to be pumped out, and it was considered fortunate if the actual work on the foundations could be begun by the first days of March. It then continued without intermission day and night until the end of June, when the Nile began to rise again. There was not time in each season to repair more than the half of either barrage. The work was, therefore, spread over 4 years.

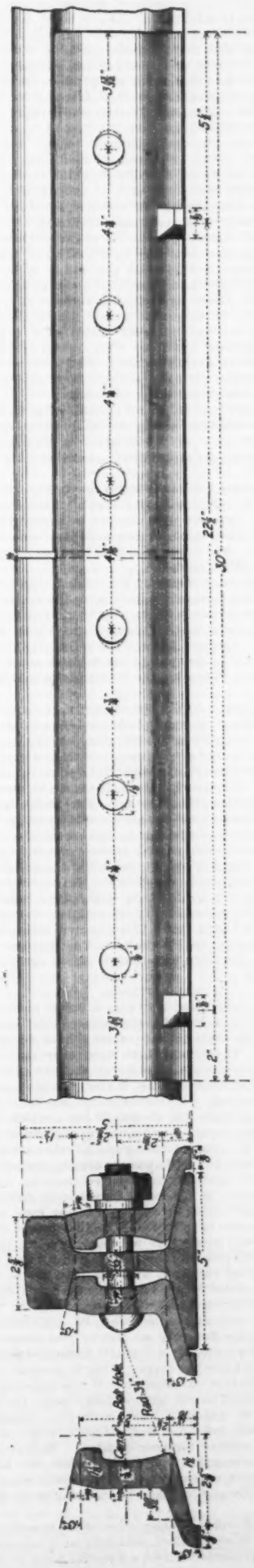
A further difficulty was due to the fact that all the time the barrage was being mended it was necessary touse it to hold the water back. From the pressure of the water, outside springs were constantly breaking out in the floor of the portion from which the water had been excluded, and on one occasion in the last season, there was a serious risk of the work being interrupted for the rest of the summer owing to a disaster of this kind. Other difficulties were constantly presenting themselves, especially in the earlier stages of the work. Almost every day some new trouble had to be faced, some new expedient invented.

In June of the present year, the structure was practically completed. The outlay up to this time was $1,964,250 and the total cost will probably fall below $2,037,000.

It is difficult to foretell the value of these works to the cotton growers of the Delta, but it is certain that the crops for the last few years have been much greater than before the barrage was used. In view of the fact that over 80% of the exports of Egypt are cotton and that this country is constantly crowding India for the second place among cotton growing countries, the completion of the Nile barrage is a matter of considerable interest to the planters of the United States.

Standard Rail Joint, New York, Lake Erie & Western R. R.

The accompanying illustration shows the standard rail joint complete as adopted in March, 1890, for the new 80-lb. rail section of the New York, Lake Erie & Western R. R. The rail section itself is also shown, but was illustrated to a large scale in our issue of Feb. 1, 1890. The joint is so fully and completely shown in all its parts in our engraving as to need no further description.



STANDARD RAIL SPLICE FOR 80-LB. RAIL, N Y., L. E. & W. R R.—C. W. Buckholtz, Chief Engineer.

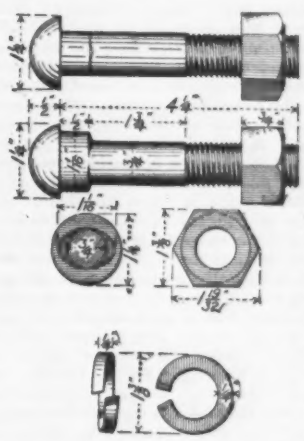
Scale, 1-4.

Electricity in Warfare.

(*Concluded from Page 250.*)

HANDLING HEAVY GUNS BY ELECTRIC MOTORS.

For quickly bringing heavy guns to point at the target, hydraulic machinery is usually employed in the navies of Europe. But in the U. S. S. *Chicago*, one of the 8 in. guns is trained by an electric motor. The gun can be trained much quicker than by hand, but this is not the real element of superiority. The real element is the absolute control possessed by the gun captain. Ordinarily, he is forced to tell somebody else which way to move the gun and how far. With the best drilling and the coolest men, mistakes and delay occur; but with the present apparatus, the gun captain, or second captain, actually moves the gun himself, just where he wants it. Of course, no man is physically strong enough to accomplish this unaided; but the motor aids him almost without his feeling it. A small lever protrudes in rear of the gun, and this lever is so connected with a peculiar switch on the motor, that the gun follows the lever like an obedient child. If the gun captain wishes to move the breech of the gun to go to the right, he moves the lever to the right, as though it were really the gun itself, and the gun immediately moves to the right, slowly or fast, just as the lever moves; and when the lever stops the gun stops; the reverse operation occurs if the lever is moved to the left. It will be seen that this plan dispenses with any arbitrary motions, so that a person entirely ignorant of electricity can control the gun just as well as could Sir WILLIAM THOMSON. The nicest and smallest movements can be obtained, as well as the largest and most rapid, and the big gun, capable of throwing a 250-lb. shell nine miles, carrying death and destruction with it, can be handled by a child.



Bolt, Nut and Washer.

Scale 1-3.

ELECTRIC AMMUNITION HOIST.

But it is not enough that guns be handled with rapidity and precision; they must be supplied with a constant stream of ammunition. The problem of supplying ammunition with sufficient rapidity to carry on a modern engagement, is coming to the front as one of the most important problems pressing for solution. The ammunition hoist now on board the *Atlanta* is a step in this direction, furnishing, as it does, a means for raising ammunition to the deck quicker than by hand, with greater safety and with fewer men, thus allowing the extra men to work at the guns. In this hoist, as in the gun-training apparatus, the same idea is carried out—*i. e.*, that of making the electric motor follow the motions of the operator's hands, both in direction and in speed. The operation of turning a wheel or crank causes the switch to start the motor in a certain direction, and the consequent motion of the motor operates to close the switch, so that a race ensues between the operator and the motor. If the operator begins to decrease the speed with which he turns the crank, the motor will overtake him, and will partially close the switch, and the motor will, therefore, lower its speed; whereas, if the operator increase his speed of movement, the switch will thereby be opened farther, and the motor will go faster. The advantage of this plan in the case of an ammunition-hoist will be apparent when it is stated that the entire time required on board the *Atlanta* to raise a 250-lb. shell is 9½ seconds. Now this interval gives a man very little time to think, especially in excitement or danger; and if the ordinary arbitrary mo ements for starting and stopping motors were employed, an accident would, some day, result from the wrong movement being made. Furthermore, with this device, if the operator is killed, or if he lets go the handle, or if, through excitement or confusion, he ceases to pay attention to the handle, or if a shot disables the motor, or breaks its connections—in all these cases, everything stops, and the shell simply stays where it is. This is a much better thing for it to do than to violently descend, or be forced up against the deck overhead, as would happen with any other device now known.

ELECTRIC MOTORS AS AUXILIARY ENGINES IN WAR SHIPS.

The two plans above described comprise the only uses, besides ventilating, to which electric motors have as yet been put in ships. But in the near future, it is expected that they will largely replace the many small steam engines with which modern war ships are filled. The most complete and detailed statement of the scope of motors fo

ship use is the lecture of Mr. S. DANA GREENE, formerly an Ensign in our navy, before the Naval Institute. Mr. GREENE, from his training as a naval officer and his practical experience as Chief Engineer of the Sprague Electric Motor Company, is probably more intimately acquainted with the technical features of the case than anybody else. He states that for a ship like the *Chicago*, the auxiliary engines that could advantageously be replaced by electric motors are about 40 or 50 in number, and aggregate about 200 HP. This estimate includes only those auxiliary engines which are at some distance from the engine and boiler rooms, and which, at present, have to be connected to the boilers by very long, crooked and expensive copper pipes. Everybody here knows that a prime necessity in a war ship is to have the pipes that convey steam, compressed air or hydraulic power, well below the water line; and everybody knows besides that a war ship of to-day is made up of a great many water-tight compartments; and so it will need no great amount of explanation to give them an idea of the trouble, complication and expense of leading the numberless pipes through the water-tight bulkheads and around obstructions. How much easier, cheaper and safer to run wires! A wire can be bent and twisted to any extent, provided only that its insulating covering be not broken. Steam pipes, furthermore, always contain more or less condensed steam, or water, the amount varying with the conditions of the case; and the conditions existing with the long and crooked steam pipes of a ship are such as to cause the amount of condensed steam to be very great. Now, this condensation, together with the friction, causes a very great decrease of preasure of steam in the engine cylinder and a great increase of back pressure; so that the steam and vacuum gauges in the engine-room convey no idea whatever of the state of affairs at an engine 200 ft. distant. In other words, there is great loss of energy between the boilers and the engines situated at a distance from them. But with the electric motor, we can certainly count on at least 80% efficiency, or at least 70% of the horse power of the dynamo's engine, and this engine is itself very economical and is placed near the boilers. But more than all this, the simplicity, noiselessness and cleanliness of the electric motor itself stamp it as the ideal engine for ship use, when compared with the noisy, dirty steam engine, with its joints, and valves and stuffing boxes and other features requiring incessant inspection.

SEARCH LIGHTS.

At the time of my previous lecture I endeavored to show the advantages of the search light for offensive and defensive operations. This would be unnecessary now, for these advantages are admitted. At that time the great body of naval officers in all countries were skeptical concerning it, and very many of the most able officers laughed at it as a manifest absurdity, and stigmatized its advocates as those horrible monsters—theorists. Moreover, not a few official reports were made, which damned search lights with faint praise, calling in question their effectiveness and exaggerating their limitations. But, of late, the weight of professional opinion in their favor has become enormous, and the endeavor is now simply to find out the best way to use them, under the various phases of war. Let any one take his stand on the deck of a ship at night, knowing that an attack—even a sham attack—is to be expected; let him feel for a few moments the helplessness that is born of darkness; let him strain his eyes and his ears in vain to detect the faintest glimmer or the faintest sound to betray boats which he knows are somewhere stealing to the attack—then let the search light dart out its brilliant ray, and throw out into merciless distinctness every detail of some boat 1,000 yds. away—swiftly and stealthily advancing—and he will need no subtle arguments to prove to him that the search light has come to stay. Of course, one must know how to use the light and when; one must not show it when he wants to keep his position secret from the enemy; neither must he use his steam whistle. But because a device may be used disadvantageously, is no argument against using it advantageously. And it is a fact that in all the recent naval manœuvres abroad, the search light has been employed to a great and increasing extent.

But it is not only in ships that we find the search light. It is used in forts, notably those defending channels, to watch for attacking vessels, and for boats attempting to countermine; and many of the continental armies have wagons which carry boiler, engine, dynamo and electric light, for use in exploring battle fields at night and in searching for the wounded and the dead.

SEARCH LIGHT IN FOG.

A novel use of the search light was made one night on board the *Atlanta*, which was caught in a suddenly descending fog in a very dangerous position in shoal water. It was not deep enough to anchor with safety, in view of the heavy sea, which was becoming hourly more heavy with the fast increasing gale; and our position on the shoals was too uncertain to warrant an attempt to get into deeper water, lest we should get into shoaler water instead. The steam-launch was lowered, and an officer in it began to sound around the ship to find a deep channel along which it would be safe to move. But the fog was so thick that it was soon found the launch could not go far enough from the ship for fear of being lost. At this juncture Lieut. G. A. CALHOUN made the ingenious suggestion that one of the search lamps be lighted, and its beam turned in a certain direction, and the steam-launch ordered to sound along the direction of this beam as far as it could be followed. The suggestion was adopted at once. It was found that the brilliant light illumined the particles of water suspended in the air to a surprising distance along a straight and narrow line. The launch would follow the ray as far as it could, sounding as it went, then return to the ship, following the guiding ray. This ray would then be turned in a new direction, and off the launch would steam to prosecute its investigations along this line. In a few hours a straight and deep channel was in this way found, and with the little launch piloting the way a short distance in advance and piping its shrill directing whistle, the big ship slowly steamed out at midnight into deep water and a safe anchorage. "This was not warfare," it may be said. No, it was not; but it gives a pithy suggestion as to how in warfare, and under certain conditions, a ship could get out of a blockaded harbor under the friendly mantle of a fog; or how a man-of-war could, under such circumstances even enter certain harbors. Of course, it would not be prudent to attempt to so enter a harbor filled with automatic electric torpedoes; but these weapons are so elaborate and expensive, that they cannot be used everywhere, and on many coasts, the main reliance must be placed on ships, shore batteries and torpedo boats.

Not only, however, are search lights of value in enabling us to discover an approaching enemy, they also enable us to see the silhouette of the gun sights on his illuminated surface, and direct the guns with precision on the darkest night.

In cases where it is not desirable to use the search light to illumine the target, a fine wire made incandescent by a current has been used with success to make visible the sights of the gun, which, of course, cannot otherwise be seen at night. The device is so good that one is surprised that it is so seldom used.

In this connection it may be here stated that there is a growing feeling in naval circles in favor of a greater number of automatic search lights, even if of small power individually, in order that all parts of the vicinity may be kept visible. Torpedo boats come so quickly that one cannot afford to let any part of the horizon remain dark while a single beam on the broadside is making the rounds.

SEARCH LIGHT WITH VERTICAL BEAM.

A curious use of the search light has been experimented with of late, and with interesting results. The lamp is so pivoted that its ray can be projected up vertically, thus throwing a brilliant shaft of light like a silver arrow, high into the air. It is stated that this beam can be seen in a fog further than anything else can. The theory is that a fog does not exist except close to the surface of the water, and that the beam can be seen by looking up into air not much obscured by fog; so that, in other words, one does not have to look through so much fog to see this beam high up in the air, as he would to see the ship using the beam. As yet only small search lights have been tried, but they have been sufficiently successful to warrant the similar trial of larger lights. [The steamers *Rhode Island* and *Connecticut*, of the Providence Line, plying on Long Island Sound, are fitted with electric search lights for use in fogs.—ED.]

RANGE FINDER.

It has been mentioned above as a prime necessity of effective gunnery at sea, that the gunners shall know at each instant the exact distance of the ship at which they are to shoot. To realize this, we must reflect that, if two ships are approaching each other at the rate of even 12 knots each, their distance apart is changing at the rate of 13⅓ yds. per second. This means that in less than 4 sec. the distance or range will change 50 yds., which represents the distance apart of two consecutive graduations on the sight bar of a modern rifled gun. In other words, the sight bars of high-powered guns are usually graduated to 50 yds., and it is necessary for effective shooting that no error as great as 50 yds. must be made in estimating the distance and timing the discharge of the gun, as the ship rolls from side to side. But if this change of 50 yds. is made in 4 secs, we see that we must have an instrument which will give the range with less than 4 secs. delay and give it at the very least with less than 50 yds. error. Such an instrument is called a range finder. It may be objected that, if you close with your enemy to "point blank range," as it used to be called, or, say, about 500 yds., then you can fire away as fast as you please, and the flight of the projectile is so nearly horizontal that you do not need to know the range. This is perfectly true, but it should be borne in mind that if the enemy's ship has a range finder, he can begin at 2,000 yds., at the least, to deliver a careful and accurate cannonade with heavy shell, and inflict tremendous damage on you while you are waiting for close quarters. Moreover, as soon as he discovers that you want to close, he will at once, and for that reason, try to defeat your plan and keep you at a distance, all the while pouring in his merciless fire.

Perhaps a few words of description of the newest range finder will not be out of place, especially as it has a number of features interesting from a scientific point of view. All know that every calculation of distance depends upon solving a triangle, in which a base line is known, and two angles at its ends are measured, these angles being included between the base line and lines drawn from its ends to the distant object. In surveying, theodolites are placed at the ends and the angles are read from their graduated limbs. In this range finder, a German-silver resistance wire replaces the graduated arc, while a receiving instrument, which is in fact a rheostat, sums up automatically the angles. The base line being a constant, the receiving instrument is marked in yards at once, instead of in angles. The operation of using the range finder, then, is this—two observers at opposite ends of the base line gaze continuously at the distant object, using telescopes preferably. They do nothing else. But a third observer, watching a galvanometer, simply moves a contact bar along a resistance wire on the receiving instrument in such a manner as to keep a galvanometer needle always at zero. His contact bar then points at the correct distance. If the object be moving, it makes no difference; the operation is as easy as if the object were stationary, and the indications are instantaneous and continuous. With a 200-ft. base line on board the U. S. S. *Chicago*, one instrument being mounted in the bow and one in the stern, the average error in the official trial was sixtenths of one per cent., and no difficulty was found in continuously reporting the distance of moving vessels.

POSITION FINDER.

Closely related to range finding is position finding, in which not only the distance of an object is obtained, but its exact position. It has been the practice in the forts of all nations to divide the harbor or other adjacent water, into imaginary squares about 100 yds. on a side, these squares being marked on a chart and numbered. Somewhere within or near the fort is a carefully measured base line, and at its ends are two telescopes or alidades, connected together by telephone, telegraph, step-by-step apparatus or other means. At some sheltered spot is the chart above mentioned, over which two pointers are arranged to sweep, being pivoted at the points representing the two telescopes. Now, if the observers at the telescopes keep the officer at the chart constantly advised as to how their telescopes are pointing, he simply moves his pointers to correspond, and the intersection of the pointers on the chart represents the object at which the two telescopes are directed. Noting the square upon which the pointers intersect, the officer telephones or otherwise signals to the guns to fire at square 110, 125, etc. Then the officers at the guns train and elevate their guns so as to fire into those squares, having at hand tables to direct them how to so train and elevate. It will be observed that guns can thus fire at a target when the smoke at the guns is so thick that the gunners cannot see the target. But Major WATKIN, of the Royal Engineers, has improved upon this method, and very greatly. The details of his invention are guarded strictly, but some of the results are known. They are simply diabolical. Gunners who could not see a target, and did not know how far off it was or where it was, have put 44 per cent. of hits on the deck of an imaginary iron clad at ranges of from 3,000 to 4,000 yds., or from 1¾ to 2⅓ miles. Perhaps in the course of a few months we shall hear of a position finder invented nearer home.

All the guns of a fort can be fired with marvelous accuracy by an officer distant from the smoke, noise and confusion of the battery, but connected with observing stations so located as to command a good view of the vicinity.

FIRING GUNS BY ELECTRICITY.

A very great increase in the accuracy of gunnery at sea is secured by the plan now coming into use in all civilized navies, by which the guns are discharged by electricity. The general idea is not new, but it is only of late that it has been made thoroughly practicable. By the old plan the gun captain ordered "right" or "left," and the sailors hauled the gun to the right or the left, or he ordered "raise" or "lower," and the sailors raised or lowered the breech of the gun. When he got the gun nearly right, the gun captain called "ready," and everybody got clear of the gun in order not to be injured by the recoil. When the motion of the ship brought the gun sights in line with the target, the gun captain pulled lustily on his lanyard, and the gun went off. But under the new system one of the sailors moves a small lever to the right or to the left, as explained above, so as to keep the gun pointed all the time in the direction of the target. The gun captain holds a small circuit-closer in his hand, and as soon as the rolling of the ship brings the sights level with the target, he simply presses his fingers, without bothering himself to see if the men are away from the gun, because the recoil will not hurt them. Knowing the exact range, and having this quiet and simple means literally at his fingers' ends, what is to prevent a gun captain from hitting the target? It must be borne in mind that the real errors in shooting at sea, are not in shooting to the right or the left of the target, but in shooting over it, or short of it. This shooting over or short arises from two things: first, having a mistaken idea of the distance; second, firing too soon or too late when the ship is rolling. Now a range finder eliminates the first error; and electric firing goes a great way towards eliminating the second error, principally because it obviates the necessity for making any allowance for delay in the firing

of the gun after the gun captain has done his part. Electricity discharges a gun at the instant when the gun captain presses his fingers, and not at some other time. So that if a gun captain, having his gun set at the correct range, presses his fingers when the sights are in line with the target, he will hit the target. Of course, errors of eyesight cannot thus be eliminated, neither can the errors of the gun; but both of these are exceedingly small, so small compared with the other errors, that they are inconsiderable, as has been abundantly proved.

MARINE PROPULSION BY ELECTRICITY.

The question is often asked: "Is marine propulsion by electricity one of the probabilities of the future?" The only way to answer this query is to decline to attempt the rôle of the inspired prophet, for while one would not have the hardihood to say that it will never be (remembering the solemn promise of a celebrated English scientist to *eat* the first steamer that should cross the Atlantic), yet on the other hand one would hardly dare to assert that it will be. The question is merely one of practicability: at present electric marine propulsion is not practicable, except on a small scale, but the difficulties in the way are of the nature often overcome by persistent experiment and by the improvements resulting from slow experience.

ELECTRIC LAUNCHES.

It can be definitely stated, however, that electric launches are so near a practical success that one does not need to be a prophet to discern their coming in the near future. No less an authority than Prof. GEO. FORBES declares that they are already a practical thing on the Thames for a certain class of boats, in which great speed is not essential, but in which quiet, easy motion and cleanliness are desirable. He further states that, in his boat, he has got a return of nearly 60 per cent. of the horse-power put into the storage cells in absolute power of the propeller. Some of the storage cells now in the market are quite durable, if not overdischarged or shaken up. I have a battery of 30 cells, of the size known as 7 M, which have been used in developing the range or position finder mentioned above, and they have fulfilled the purpose exactly. They were originally charged last July, and they did not have to be recharged until a month ago. They were used on board the U. S. S. *Chicago* for some months, and were subjected to a good deal of rough treatment, being moved about the decks a good deal, lowered down into a store-room and hoisted up on deck again a number of times; besides this, the sailors spit tobacco juice on them, and then played salt water on them with a hose, to wash them. The sailors called the case containing the cells the "box of electricity." At first they looked at it with the contempt which every true man-of-war's man feels for anything scientific; but they generally acquired for it a certain respect, as time went on, and they saw what curious things the ugly black box could do.

One of the newest electric launches is *The Magnet*, 28 ft. long and 6 ft. beam, drawing 2½ ft. of water. She carries 56 accumulators, weighing 2,400 lbs., or about as much as 15 men, and these accumulators furnish the energy to drive an electric motor whose armature is on the same shaft with the propeller. It is claimed that this boat can carry 20 people in smooth water, and that she can go 80 miles at a speed 6 to 8 knots, or go a shorter distance at a speed of 8 to 10 knots. It would seem as if, even at the present stage of development such a boat would be valuable in a war ship, from the fact that it can be got ready for service instantly, and can go faster and longer than an ordinary man of-war's boat pulled by oars.

It could do excellent work, for instance, in case of a fleet at anchor, in carrying dispatches from ship to ship. The cells in the boat could be charged while the boat was lying alongside, or even when hanging at the davits, and in such emergencies as are constantly occurring in naval life it could be lowered and started off in a few seconds; while for scout duty or lookout duty, what other boat could be so noiseless and swift?

ELECTRIC SUBMARINE BOATS.

Closely allied to electric launches are electric submarine boats, in which also the energy needed for propulsion is carried in storage cells. The newest vessel of this class about which much is known is the Spanish submarine torpedo boat *Peral*. Trustworthy details are hard to get, but there seems to be no doubt that she can remain under water for hours, can move at a high speed both above and below water, and that she can carry enough energy in the storage cells to enable her to carry out any attack which a submarine boat is intended to make, *i. e.*, a sortie from a harbor upon an attacking fleet.

ELECTRIC COMMUNICATION BETWEEN SHIPS AT SEA.

I fancy that everybody here is aware of the fact that the great need of all navies is a quicker and more trustworthy means of communication between ships at sea. Doubtless, most of you know also that many experiments have been made looking to the establishment of a means of communication by electricity. Two general lines of experiment have been followed. In one, sound vibrations are set in motion in the water, and are received on a diaphragm, usually on the under-water side of a ship; this diaphragm corresponding to a telephone transmitter, the receiver being in the pilot-house, or other convenient place. The other line contemplates sending electric signals through the air or the water, the receiver being usually a telephone receiver. During about two years, a great many experiments were made at the New York Navy Yard in the latter line, signaling both through the air and through the water. These experiments were on a pretty large scale. A large dynamo was used as a source of power, and in one case the U. S. S. *Atlanta* was converted into the largest electro-mag. net known, being wrapped with heavy wire, through which the dynamo current was sent, while the iron tug *Nina*, 150 ft. long, was made a receiver, she being wrapped with fine wire having a telephone in circuit. But the most satisfactory results were got by sending the impulses through the water; and though nothing quite practical was reached, yet one felt all the time that it was because he was not prosecuting the experiments correctly. These experiments seem worthy of mention, because they indicate one of the few fields of electrical engineering not yet explored.

ELECTRIC SIGNALING.

But electric signaling by lights is already a practical thing, and is used in all navies. It is not the ideal thing, and does not attempt as much as the plans above mentioned. But it is a great improvement on the old plans and can do good work with skilled operators. The plan most employed is to make and break the circuit of incandescent lamps, and thus signal letters and words according to a preconcerted code. But when distant signaling is desired, between points ten miles apart, for instance, or when high land intervenes, then the penetrating ray of the search light is flashed into the sky.

NECESSITY FOR EFFICIENT EQUIPMENT OF WAR SHIPS.

In conclusion, if we compare the art of electricity in warfare at its present stage with that prevailing five years ago we will see that a comparatively unimportant thing has grown to be an important thing, and that scientific apparatus is employed much more than it was then.

Now this indicates the tendency in modern warfare; a tendency to accomplish a desirable end by any effective means, no matter how complex or how expensive. Certain objects must be attained. If a ship is to go into a fight, she must whip. A lost battle is a national regret forever. A single ship, a small one perhaps, like the *Kearsarge* may fight a battle, and of which the consequences will be altogether out of proportion to the money value of the ship. There are thousands of buildings in this country that cost more than did the little *Kearsarge;* but suppose this cheap little ship had been sunk by the *Alabama*. The thought is unendurable. Now every nation feels that each of her ships is an exponent of what she can do in that tonnage, and while no nation feels bound to build ships, each one of which can whip any ship in any other navy, she does feel bound to build and equip each ship well enough to whip any foreign ship of her size and weight. So modern ships are coming to be the foremost examples of the application of science to practical things.

TENDENCY OF MODERN WARFARE.

The sailor is still a sailor, and will always be a sailor, so will the soldier always be a soldier. The profession of arms, whether on land or sea, calls for and develops certain qualities of mind and heart. Endurance, decision and chivalric courage will win battles in the future, as in the past. The grand principles of strategy persist, and so do the laws governing the command of men. Yet the *conditions* of warfare are changing. Simplicity is giving place to complexity. Woe to that nation which fails to note the signs of the times! War is a serious thing, but it is more serious to the vanquished than to the victor. It behooves every nation to see that by no chance shall it be vanquished. No means of offense or defense must be neglected, because it seems too delicate or too expensive, provided only that it can be made to be efficient. Science is daily coming more into our lives, as the number of those who study her increases; but in no department of life is she making more progress than in warfare, and in warfare no branch of science is making more progress than electricity.

The Influence of Current on the Friction of Sliding Surfaces.

In a recent number of the *Electrical Engineer*, Mr. L. M. SCHMIDT published an account of the changes in the coefficient of friction produced by sending a current of large quantity through the sliding surfaces of contact, from which we abstract as follows:

The experiments were conducted with an electric welding machine at the laboratories of the Thomson Electric Welding Co. A small current of great E. M. F. was sent through the primary coil and a large current of low E. M. F. was thus induced in the secondary circuit, consisting of a large horseshoe of copper, each end of which supported a copper block. These blocks were connected by copper conductors and were made to slide over the ends of the secondary coil by pulleys, cords and weights. Each block had 30 sq. ins. of bearing surface and weighed 40 lbs.

The results of the experiments are shown in the accompanying diagram. The horizontal distances give the approximate total current in amperes. The current per square inch of bearing surface can be found by dividing the amount represented by any abscissa by 30. The vertical distances give the coefficients of friction.

The curve *A* was obtained by allowing the current to flow through the surfaces of contact for 20 seconds before applying the weights; curve *C* (practically a horizontal line) was obtained by turning on the current and applying the load almost instantaneously, and curve *B* was obtained in the same way, but using surfaces lubricated with mineral oil the other experiments being with dry surfaces.

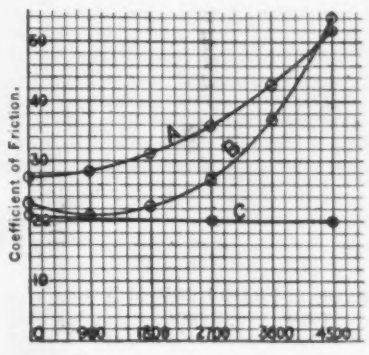
The deduction that may be made from the above results is that the influence of the passage of current upon the coefficient of friction for sliding copper surfaces is:

First, to increase the coefficient of friction of repose.

Second, to slightly decrease the coefficient of friction of motion, within the limits tried to about 100 amperes per sq. in. of surface (curve *C*).

Third, that the effect of oil with other than weak currents relatively to cross-section of conducting surface would be to largely increase the coefficient of friction.

In ENGINEERING NEWS of Aug. 9, 1890, is a description of some experiments of similar nature but made with a locomotive and rails for instru-



Variation in Coefficient of Friction due to an Electrical Current.

ments. It would be interesting to see if the addition of a little oil to the top of the rails would increase the tractive force of the locomotive in the same ratio that a similar addition did the coefficient of friction between the copper surfaces. If so it would certainly be a novelty in railway practice. The coefficients of friction will be seen to have run up very high, even with these light weights, from which it is a fair inference that they would be still higher yet with the heavy loads on locomotive drivers under otherwise equal conditions; thus in a measure supporting the claims which are made for the practical utility of this method of increasing tractive power.

Legal Decisions of Interest to Engineers.

Injury of Passenger at Station.—A passenger on one of defendant company's trains started to get off when the name of his station was called, the train had not reached the platform, but as it often stopped there, and a rule of the company required other trains to stop in case a train should be letting off passengers at this point, was known to the complainant, he did not look out before getting off and was injured by a locomotive passing on another track. Such failure to look was not contributory negligence and the complainant can recover. (Philadelphia, W. & B. Ry. Co. v. Anderson, Court of Appeals of Maryland, 20 At. Rep., 2).

Liability of Railway Company for Fires on its Right of Way.—Where a railroad company negligently permits any grass and other combustible matter to accumulate upon its right of way, which is set on fire by a passing engine, and the fire is negligently permitted to escape to the land of an adjoining owner, without negligence on his part, the company is liable for the injury resulting from such fire. (Chicago, St. L. and P. Ry. Co. v. Burger, Supreme Court of Indiana, 24 N. E. Rep., 981.)

Pollution of Water Supply by Public Sewers.—In order to obtain a preliminary injunction restraining the construction of public sewers as liable to pollute the water supply of a city, it is necessary to show that the pollution is immediately threatened, and that it would be deleterious to the city. (Newark Aqueduct Board v. City of Passaic, Court of Errors and Appeals of New Jersey, 20 At. Rep., 54.)

Negligence in Walking Along the Street.—Where one was walking along the street, fell into an area way which was not guarded, nor was there anything to call his attention to it; but could have been seen by looking at it, he was not as a matter of law negligent in not seeing the opening. (Matthews v. City of Cedar Rapids, Supreme Court of Iowa, 45 N. W. Rep., 894.)

Foundations of the Red Rock Cantilever Bridge.

The foundations for this bridge, of which we shall give next week full drawings and descriptions, were 2 concrete anchor piers, 2 masonry piers, 6 small pedestals for viaduct approach and a wing wall abutment, all as shown in the general sketch. The work was begun by Sooysmith & Co., contractors for the substructure, in September, 1888, but all operations were suspended the following spring, owing to the extreme heat, and then resumed in September, 1889. The anchor piers were made entirely of concrete, founded on the solid rock, and were built up from open excavations.

The footing of the east pier was just above low water level, and the west pier was considerably above high water mark.

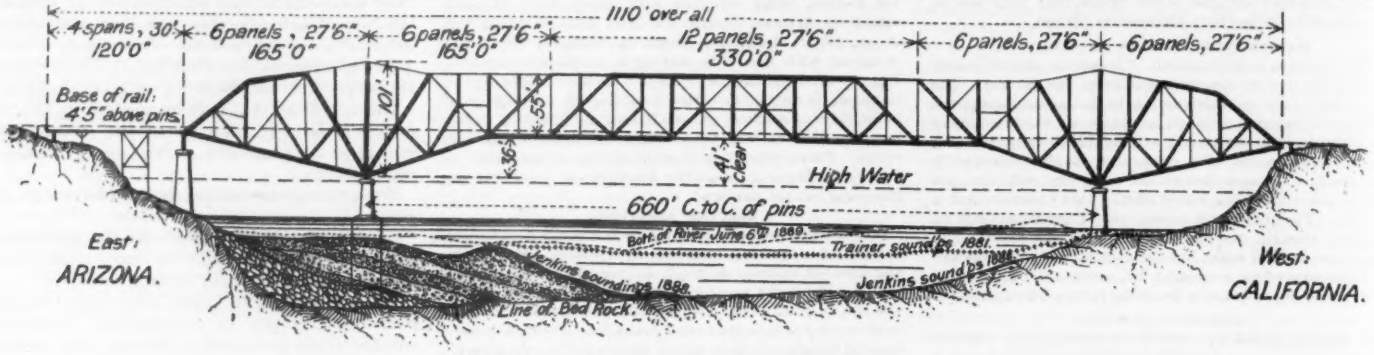
The concrete was deposited and rammed in layers 9 ins. thick, and was confined to its proper dimensions by a frame work of joists and planking, which was carried up, as the pier was built, in sections of 5 ft. After the concrete was thoroughly set the wooden frame was removed, and the entire pier plastered over with cement mortar.

On the east shore, bed rock is about 80 ft. below the surface, and is overlaid with sand, gravel and boulders; it was in the sinking of this pier that the first trouble was encountered.

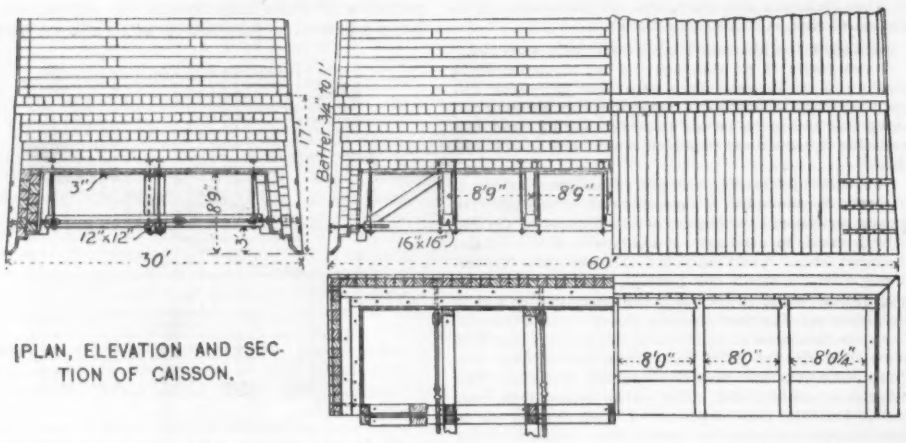
The water here was very shallow, being only about 1 ft. deep at ordinary stages, and as it would thus be impossible to float a caisson from the shore to the site, it was necessary to build it in position.

A crib of timber was built about the site, sufficiently large to allow room for men at work in building caisson. This crib was then filled in with earth until about 2 ft. above the water's surface, and the caisson was built within the enclosure, resting upon blocking, which was undermined and removed when air-pressure was put on.

The caisson was framed after the plan shown in the accompanying cuts. The timber used, both in caisson and in the cribbing was 12 × 12-in. Oregon pine, with the exception of the plank sheathing and the ties in the caisson chamber which were 16 × 16-in. timber. The sides of the caisson were 3 ft. thick, and lined with 3 in. planking, all firmly fastened together, horizontally by screw bolts and vertically by drift bolts.



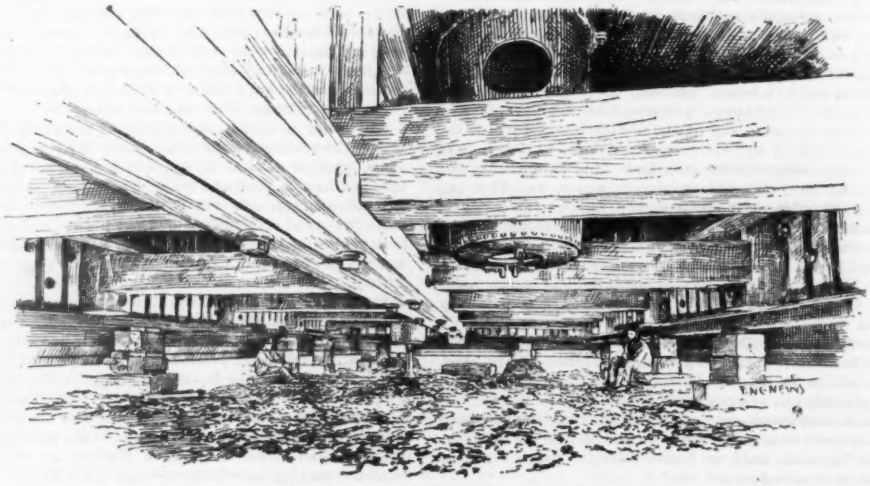
GENERAL ELEVATION OF RED ROCK BRIDGE.



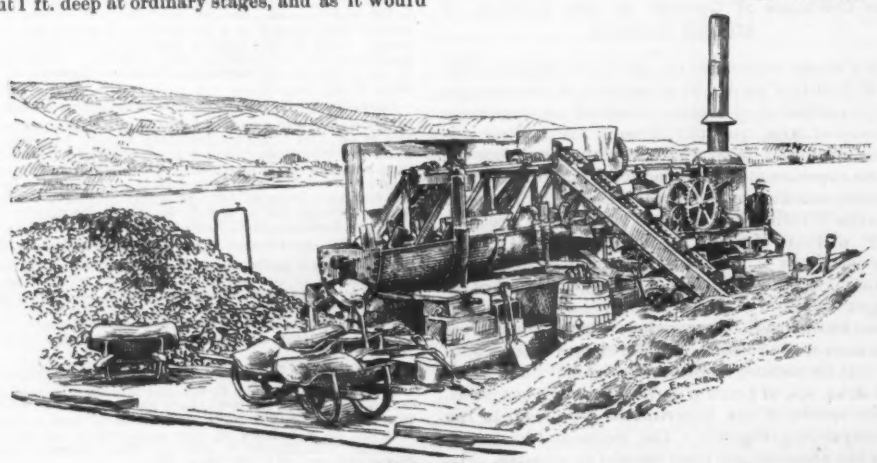
PLAN, ELEVATION AND SECTION OF CAISSON.

The excavating chamber was 54 ft. × 24 ft. × 8 ft. 9 ins. in the clear, divided into 12 working pockets. There were two excavating shafts, one supply shaft, and one main shaft; a 4-in. air pipe and blow-outs were used. About 375,000 ft. B. M. of timber were used in the caisson and crib. Sinking was begun Nov. 21, 1889, and owing to the very hard materials, proceeded slowly, the average being about 10½ ins. per day. At a depth of 61 ft. below low water a layer of unusually compact boulders was encountered, and on this the foundation was made, bed rock being still 20 ft. deeper. The chamber was then filled and air taken off Feb. 5, 1890. The concrete used throughout the work was made of English Portland cement. Most of the stone used was gathered on the hills of the sorrounding country, and was sent to the mixer without other preparation than being screened.

The proportions of concrete were: for filling chamber and crib of east pier, 1 cement, 3 sand, 4 stone; and for the anchor piers and masonry backing, 1 cement, 2½ sand and 4 stone. The mixing of concrete was very easily and effectively accomplished by the concrete mixer, shown herewith, the design of Mr. CHAS. SOOYSMITH. The machine is made so that it may mounted on wheels and drawn from one place to another, where there is but little work to be done in any one place.



VIEW SHOWING INTERIOR OF CAISSON.



CONCRETE MIXER.

The engine directly back of the machine runs two lines of shafting, over the shell, and also a pump that regulates the water supply. To this shafting are attached, by means of an endless chain, the buckets which raise and dump the materials for mixing. The buckets for cement and sand are on different shafts, and are directly opposite one another. When the machinery is started these buckets are filled and by motion of the shafting are wound up and dumped into the shell, where a wrought iron worm thoroughly mixes them dry, at the same time working the mixture along the shell, where after a short distance the water enters and the sand and cement are made mortar. Passing on further the stone is dumped into this mortar and the whole is kept moving toward the opening in the end of the shell, where the now well-mixed concrete is received in barrows or buckets and deposited as desired.

The great advantage possessed by the machine lies in the fact that the actual measures of the cement, sand and stone may be arrived at by adjusting the distances between the buckets on the chains or by making the buckets of different sizes.

The Report of the Interstate Commerce Commission's Statistician.

THE ORGANIZATION OF RAILWAY PROPERTY.

Continuing from Aug. 23 our review of this report, we find the statement that 1,705 different corporate organizations were the owners of the railway property reporting. The bulk of these organizations, however, operate very small local lines or have merged their property in some of the great systems, so that only 33 corporations (each of which operates a system over 1,000 miles in extent) operate almost half (49.00%) of the total mileage of the country.

Really, however, the concentration of railway property is much greater than is indicated by this, as the table does not take into account the financial relations between the operating corporations, nor the extensions and consolidations made since June 30, 1889. By a table published in our issue of June 7, 1890, it was shown that 11 corporations now control 76,543 miles of railway, or between 47 and 48% of the total in operation at the close of 1889. Adding to this the mileage controlled and operated by other companies operating over 1,000 miles and we have a total of 101,901 miles, controlled by 21 different companies, as the total mileage comprised in systems over 1,000 miles in extent.

A very interesting table is given showing the mileage, gross and net revenue, passenger and freight mileage per mile of line for all companies whose gross revenue exceeds $3,000,000, of which there are 69 (52, on eliminating subsidiary corporations).

The Pennsylvania system is easily at the head as regards gross revenue, the whole system having a total revenue of over one hundred million dollars ($122,917,337 in 1889, according to the company's own report). The statistics of the Interstate Commerce Commission give the income of each corporation of the system separately, however, putting the Pennsylvania R. R. (2,432 miles, comprising most of the lines in New Jersey and Pennsylvania) at the head with $57,719,083 gross income. Next come the Southern Pacific with $43,292,582 gross receipts and the New York Central & Hudson River with $34,960,901. About as much more was earned by the Michigan Central and Lake Shore & Michigan Southern lines together, and the total income of all the Vanderbilt lines east and west of Chicago amounted to considerably over 110 million dollars. In gross earnings per mile the Delaware, Lackawanna & Western stands at the head with $24,909; but the Pennsylvania, New York Central, Philadelphia & Reading and Boston & Albany have nearly as much. The coal roads and trunk lines, of course, have the heaviest gross earnings per mile, although the New England roads closely approach them.

Some of the Southern roads show a heavy traffic. The Cincinnati, New Orleans & Texas Pacific earns $10,850 per mile, and the Norfolk & Western $8,635. The Chicago, Burlington & Quincy, and the other similar systems operating northwest and southwest from Chicago, all earn $4,500 to $6,000 per mile. In the Southwest earnings are lower, between $3,000 and $4,000 being the rule, with the exception of GOULD'S St. Louis, Iron Mountain & Southern, which earns nearly $7,000 per mile. The Pacific roads show remarkably large receipts. The Southern Pacific earns $7,217 per mile on its immense system of nearly 6,000 miles. The Union Pacific earns over $10,000 per mile. The Canadian Pacific, however, over whose severe competition with our American lines so much has been said, earns only $2,769 per mile. It is probable that a good part of these heavy earnings of the Pacific lines are due to high rates rather than heavy traffic. The average gross earnings per mile for the whole United States were $6,290.

From the table of net earnings, which so deeply interest the owners of the roads, it appears that coal is a very profitable traffic to handle. The Philadelphia & Reading and the Central Railroad of New Jersey net over $10,000 per mile of road. The only other roads which approach this handsome profit are the Delaware, Lackawanna & Western, $9,808; the Boston & Albany, $9,192; the New York Central & Hudson River, $8,736; the Pennsylvania, $7,562, and the Delaware & Hudson Canal Co.'s Albany & Susquehanna line, $6,600. All the rest net below $6,000 per mile and most of them a good deal below it. Among the very low ones are the Atlantic & Pacific, $78 per mile; the Rock Island's lines in Kansas & Colorado, $454 per mile, and the Missouri Pacific and Canadian Pacific, each of which nets between $950 and $1,000 per mile. The average for the whole United States is $2,087 per mile.

In passenger mileage per mile, the New York New Haven & Hartford is far in the lead with 567,628. Next is the Boston & Albany with 500,802, the New York Central with almost exactly 400,000, the Long Island with 336,246, the Boston & Maine with 301,401, and the Pennsylvania with about 289,000. The others run rapidly down, and the smallest are the Fremont, Elkhorn & Missouri Valley, the Missouri, Kansas & Texas and the Chicago, Kansas & Nebraska, each of which have between 19,000 and 20,000 per mile. The average for the whole United States, according to Poor, was 78,366.

In ton mileage of freight per mile of road the Pennsylvania is far in the lead with 2,397,851 ton miles per miles. Four other companies—the New York Central, Erie, Lackawanna and Delaware & Hudson Canal Co.—have between 1,900,000 and 2,000,000 ton miles per mile, and then the list runs down so rapidly that only 13 other companies have over 1,000,000 ton miles per mile. At the bottom of the list are the Chicago, Kansas & Nebraska and Fremont, Elkhorn & Missouri Valley, with less than 90,000 ton miles per mile of road. The average for the whole United States was 437,750 ton miles per mile of road.

CAPITALIZATION OF RAILWAY PROPERTY.

The principal matter of interest in this part of the report is the matter regarding the bonded debt of railway companies. It appears from the statisticians' researches that in general this seems to be regarded as a permanent obligation. In only 74 cases have railway managers provided any sinking fund for the payment of bonds when due, and the general practice is to take up bonds when due by the issue of more bonds. The statistician brings up the question whether it is best for the public that this debt of the railway companies should be thus perpetuated, but does not attempt its discussion. He points out that the progress of consolidation is, in some measure, acting to reduce railway capitalization, especially as regards bonded debt.

A very interesting table shows the amount and percentage of stock and bonds yielding various rates of income. Of the total outstanding, 61.67% of the stock paid no dividends, and 18.19% of the bonds paid no interest. The following table shows the percentage of the total stock and bonds yielding various rates of income:

Rate paid.	Per cent. of total stock.	Per cent. of total funds.
Nothing	61.67	18.19
Less than 3%	5.83	3.76
3% to 5%	10.07	20.92
5% to 8%	17.80	55.51
Above 8%	4.63	1.62
	100.00	100.00

TRAFFIC STATISTICS.

The average passenger journey was 24.47 miles in length, and the average number of passengers per passenger train was 42. The average length of haul of freight was 127.36 miles, and the average weight of the freight carried per freight train was 179.35 tons, a surprisingly high figure when it is considered how light are the freight trains on the great mileage of railways in the newer parts of the country. The statistics show also that the total traffic amounted to 175.58 passenger miles and 1,041.32 ton miles per inhabitant.

The complete statistics of earnings compared with the report for 1888 show a decrease in gross income per mile of $363, and a decrease in net income per mile of $220. The statistician explains, however, that this is due to the fact that this year's report includes a greater number of small, inferior lines. Had the same lines which were included in the report for 1888 been taken alone, a slight increase would have been shown. In 1889, of the total earnings from operation, 30.40 per cent. was due to passenger service and 67.35 per cent. to freight service. In 1889 passenger service increased to 31.10 per cent. and freight decreased to 66.82 per cent.

In the following table the classification of operating expenses on 153,385 miles of railway is given:

Source of expenditure.	Amount.	Per cent. of total operating expenses.		Per cent. of total expenditures.		Per cent. assignable to: Passenger service.	Freight service.	Passenger service.	Freight service.
		1889.	1888.	1889.	1888.	1889.		1888.	
Maintenance of way and structures	$144,821,953	22.46	22.60	15.54	15.27	38.79	61.21	37.85	62 15
Maintenance of equipment	106,709,258	16.55	17.09	11.45	11.55	32.08	67 92	32.46	67 54
Conducting transportation	330,915,439	51.33	50.26	35.49	33.96	33.19	66 81	33.86	66.14
General expenses	60,820,469	9.44	9.34	6.52	6.32	40.37	59.63	39.05	60.95
Fixed charges	287,624,410	.....	.....	30.85	32.42	.....	.....	.....	.....

The total expenditures for the year on all roads were $988,597,095. The income account for the year ending June 30 is given as follows:

		Per mile of line.
Gross earnings from operation	$964,816,129	$6,290
Less operating expenses	644,706,701	4,203
Income from operation	320,109,428	2,087
Income from other sources	125,160,702	816
Total income	445,270,130	2,903
Deductions from income:		
Interest on funded debt accrued	213,173,672	1,389
Interest on interest-bearing current liabilities accrued, not otherwise provided for	6,795,937	44
Rentals, including tracks, yards and terminals	96,330,391	628
Taxes	27,590,304	179
Total deductions from income	343,890,394	2.242
Final net income	101,388,736	661
Dividends, 1.91% common stock	70,025,180	.....
Dividends, 2.11% preferred stock	12,085,018	.....
Total	82,110,198	535
Surplus from operations of year	19,278,538	126

In the following table the rapid fall in cost of transportation and the corresponding reduction in rates is clearly shown:

	1889.	1888.
Revenue per pass. per mile, cents	2.165	2.349
Average cost of carrying one passenger one mile, cents	1.993	2.042
Revenue per ton of freight per mile, cents	0.922	1.001
Average cost of carrying one ton one mile, cents	0.593	0.630
Revenue per train mile, passenger trains	$1.06.287	$1.13.952
Average cost of running a passenger train one mile, cents	83.068	84.601
Revenue per train mile, freight trains	$1.65.377	$1.65.712
Average cost of running a freight train one mile	$1.06.481	$1.03 876
Revenue per train mile, all trains	$1.39.191	$1.46.719
Average cost running one train one mile, all trains, cents	94.868	96.050
Percentage of operating expenses to operating income	66.81	65.34

The Best Type of Electric Street Car.

At the meeting of the New York Street Railway Association at Rochester, Sept. 16, JOHN W. MCNAMARA, President of the Albany Street R. R. Co., read a paper on "An Electric Street Railway Motor," from which we make the following extract :

At the time of the introduction of the electric motor, the ordinary street car drawn by horses was the most convenient vehicle in public use. It was easy to enter and easy to alight from. The various makers had vied with each other until one was able to step as easily from the street into a car as he could ascend two steps of his own stairs. The early builders of electric cars endeavored to retain this feature of the street car,and placed the motor proper on the car, communicating motion to the axles by means of sprocket wheels and chains; but the mechanical difficulculties, and the noise made by the chains and wheels led to their abandonment, and the motor or motors were then placed on the axles and *under* the car, where we find them to-day.

At first the easy-of-access feature was retained. but as the necessity for larger motors and more room for them became apparent, the car body was gradually raised until it is too high for children and elderly people to enter readily, and a great deal of time is consequently used in receiving and discharging passengers.

The car body has been raised at the expense of comfort, without, it seems to me, improving the condition of the motor. It is still under the car near mud, dust, snow and slush, and is as difficult to get at as it ever was.

With these exceptions the electric motor of to-day is well nigh perfect, but these exceptions, as time goes on, will become more serious. When the novelty of being regularly and rapidly carried to their homes and places of business ceases, then passengers will call attention to the difficulty of entering and leaving cars.

The size of the motor car, especially for use on grades, should not exceed the standard 16 ft. for box cars and about 25 ft. for open cars. On level and suburban roads where the headway is not less than 20 minutes, larger cars with 8 wheels might probably be economically used; but for populous cities where headway is less than 5 minutes, the old standard car body is, in my opinion, the best.

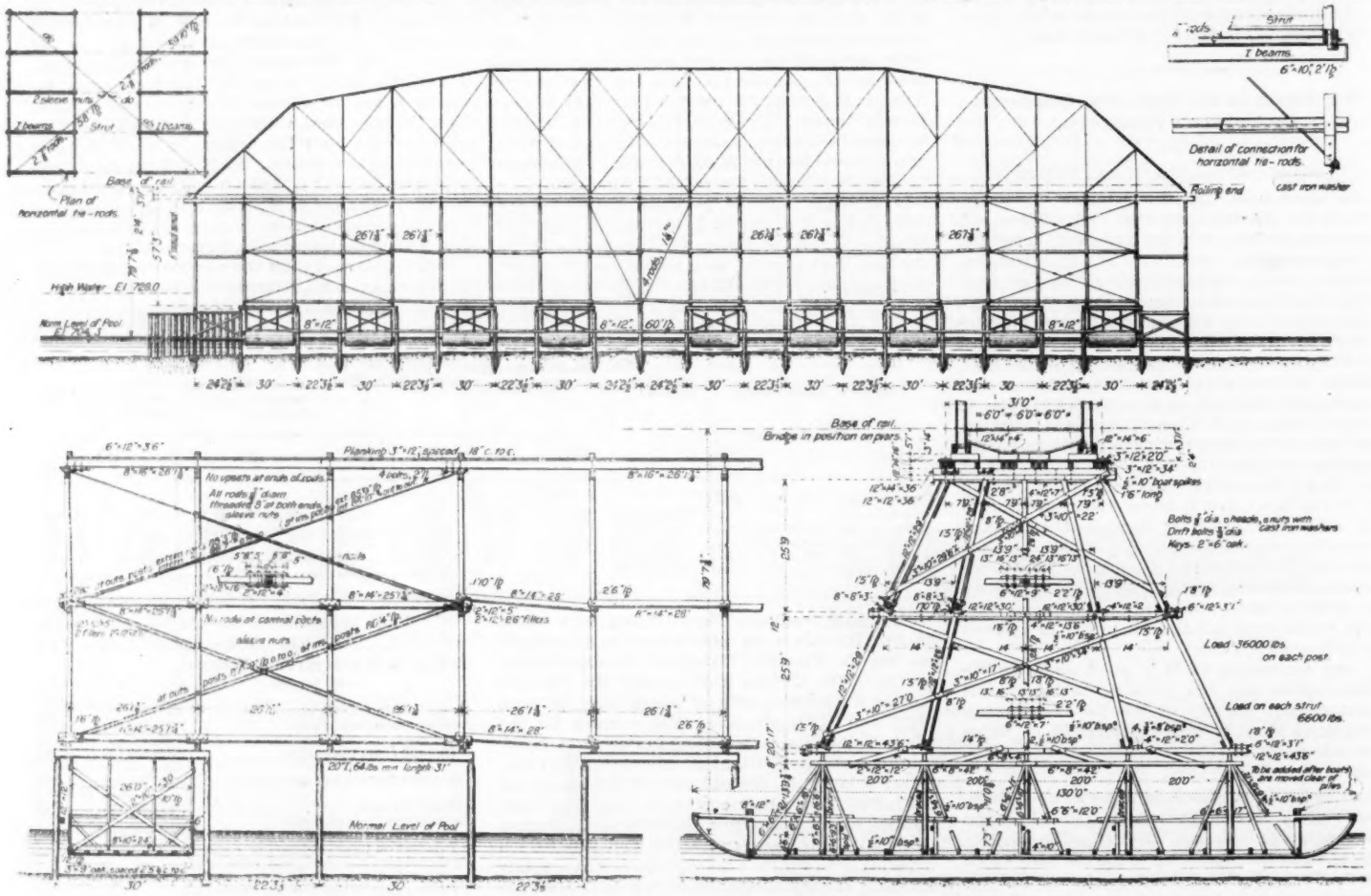
How the motor is to be arranged with reference to the car body so as to admit of easy access to it for examination and repair may, or rather must, be left to mechanical and electrical engineers. That we will continue to drag them in the dust and mud very long I cannot believe.

I think the opinion of all who are unprejudiced is that the overhead single trolly under-contact systems are the most reliable and efficient. With good overhead construction the loss of power in transmission is but slight, and the conductors are always where they can be seen and kept in place.

The ideal motor is one which is independent of every other motor or other engine, and contains everything necessary to make it go. This motor exists and seems to work fairly well on grades of not more than 5%; but that it is capable of doing the work now being done by motors using the overhead system is still problematical. However, as we have already witnessed such wonders in propelling cars by electricity, may we not hope for a storage battery electric car which shall be equal to any now in use?

False Works for Main Spans of Ohio Connecting Railway Bridge.

Supplementing the data given last week of the interesting operation of floating the main span of this great bridge into place, we give herewith an engraving showing the plan of false works. There were some changes made of an unimportant nature, which it was not deemed necessary to redraw on this plan; for instance, in addition to the diagonal rods running over three bays, between trestles, some wooden braces were introduced, and the diagonal rods at the one end of the structure were moved toward the center to avoid having to change them when shortening the false works for use in the 416 ft. span. Also, in addition to the diagonal rods used in the plane of the bottom sills of the trestles, some wooden braces were used. The plan also does not show the shoring used to stiffen the tension members of the trusses. The views published last week show clearly what was done in this way. But with these minor exceptions our drawings show the false works exactly as constructed, and show their details so clearly as to need no further description.


Plan of horizontal tie-rods.
Base of rail
High Water El. 709.0
Normal Level of Pool
Bridge in position on piers
Normal Level of Pool
Load 36000 lbs. on each post
Load on each strut 6600 lbs.
Detail of connection for horizontal tie-rods.
Rolling end
cast iron washer

FALSE WORKS FOR MAIN SPANS OF OHIO CONNECTING RAILWAY BRIDGE.

Recent Discoveries of Petroleum.

Consul BISSINGER of Beirut, Syria, reports that petroleum has been discovered some 14 miles west of Alexandretta, in the province of Aleppo, and from 1½ to 2½ miles from the sea. The company opening the wells has agreed to pay an annual tax of $3,200 for the exclusive use of the field, and a duty of 10 per cent. of the value of the unrefined product. The general opinion is reported as regarding the discovery of little value.

Consul HOLLIS, of Cape Town, So. Africa, reports the existence of extensive petroleum strata in the Potchefstroom district, So. African Republic. Mr. A. A. ANDERSON, a civil and mining engineer of Johannesburg, found a pond at Vetpan on the surface of which petroleum was floating. The mud along the shores was thickly impregnated with a hydro-carbon oil which burned freely with a smoking flame. A company was formed to develop the deposits, but on April 12, the date of the last report, the oil ledge had not been reached owning to defective drilling apparatus. At Bashack, 7 miles from Vetpan, a 16-ft. oil-bearing stratum was long known to the Boers, who obtained their wagon grease by squeezing the oily mud in pieces of cloth Near Kimberly, the Gilead P. Beck Oil Co. has a large tract of land on which active prospecting was going on in April. The oil is obtained from a shale, producing at times as high as 10 galls. of oil to the ton of rock.

Consul DICKSON of Gaspé Basin, P. Q., reports that in June Mr. JAMES FOLEY had sunk 2 wells, of 2,500 and 1,000 ft. depth respectively, the latter giving a large flow of good oil. The work is done for the Petroleum Oil Trust, which owns some 50,000 acres in the vicinity. It is said that 4 more wells will be sunk immediately. The International Oil Co., of St. Paul Minn., has also begun a well.

THE ELLIOTT CRESSON MEDAL of the Franklin Institute, Philadelphia, has been awarded to Ottmar Mergenthaler, the inventor of the "Linotype" mechanical typesetter, illustrated and described in ENGINEERING NEWS of May 25, 1889.

A FOSSIL OF GREAT SCIENTIFIC INTEREST has been discovered in a sandstone quarry at Buckland Conn., and is now in the museum of Yale College. The fossil is that of one of the large reptiles whose footprints in the sandstone found in the Connecticut River Valley are preserved in many museums. The reptile was a lizard-shaped creature about 8 ft. in length.

AN UNSUCCESSFUL ATTEMPT TO TAKE SOUNDINGS OFF CAPE HATTERAS for the new Diamond Shoal lighthouse was recently made by Mr. J. F. ANDERSON, of the firm of Anderson & Barr. Stormy weather prevented the party from launching the raft from which the soundings were to be made, and the waves ran too high for the steamer carrying the party to anchor over the proposed site.

WORK ON THE TAMPICO HARBOR JETTIES is being pushed as rapidly as possible by the Tampico Harbor Co., controlled by the Mexican Central R. R. The harbor is formed by the Panuco River, which is said to discharge 215,000 cu. ft. of water per second, more than that which passes through the South Pass of the Mississippi. According to a recent consular report it is probable that at least a 16-ft. channel will be cut through the bar before the close of the present season, and that a depth of 24 ft. will be obtained and the jetties practically completed by March 1, 1892. Mr. E. L. CORTHELL, who was Resident Engineer in charge of the construction of the Mississippi jetties, is Chief Engineer of the works, and Col. A. F. WROTNOWSKI is Resident Engineer.

TRAIN WRECKERS derailed a train on the Louisville, New Orleans & Texas, at Vicksburg, Miss., Sept. 17, and the engineer and fireman were killed. At Wyoming, N. Y., Sept. 18, a Buffalo, Rochester & Pittsburg freight train was derailed by wreckers, but no one was injured. Another futile attempt at train wrecking occurred on the Chicago & Northwestern, within the city limits of Milwaukee, Wis., on Sept. 18. Three of the men who were concerned in the recent train wrecking on the New York Central & Hudson River R. R. have confessed. Evidently more stringent laws against attempts at train wrecking are needed.

A BOILER EXPLOSION occurred Sept. 21 on an East Tennessee, Virginia & Georgia locomotive near Chattanooga, Tenn., killing the engineer and fireman. The coroner's jury held the company responsible.

PERSONALS.

Col. G. R. DAVIS has been appointed Director-General of the World's Fair.

Mr. GEO. A. COE has been appointed Assistant Superintendent of the Chicago & Erie R. R.

Mr. J. K. MCCRACKEN has been appointed General Manager of the St. Louis & Texas Ry.

Mr. J. O. KEIM has been appointed General Superintendent of the Delaware River & Lancaster R. R.

Mr. JAMES HOLME, of the Canadian Pacific Ry. engineering staff, died recently at his home in Winnipeg, Man.

GENERAL SUPERINTENDENT SCOTT of the Gulf, Colorado & Santa Fe Ry. has resigned his position in order to go to Europe.

Mr. W. W. ARNOLD has been appointed the successor of Mr. T. SEYMOUR as Superintendent of the St. Louis, Alton & Springfield R. R.

Mr. GEO. R. KAERCHER, General Solicitor of the Philadelphia & Reading R. R., was killed in the railway accident on that road of last week.

Mr. C. B. COUCH, formerly Superintendent of the Eastern Division of the Lake Shore, has been appointed Purchasing Agent of the same road.

Mr. W. E. LEWIS, Assistant Superintendent of the Long Island R. R. died Sept. 19 at Long Island City. Prior to his appointment on the Long Island road he was Superintendent of the Mexican Central Ry.

Mr. ELLIOTT HOLBROOK has been appointed Superintendent of the Baltimore & Ohio R. R. He will succeed Mr. PATTON, who resigned to accept the office of General Manager of the Pittsburg & Western R. R.

Mr. E. SHERMAN GOULD sails Sept. 27 on the steamer *Yucatan* for Havana, Cuba, with a force of American workmen to complete the Vento Water-Works for Messrs. Runkle, Smith & Co., the contractors of the same.

Mr. J. K. BECK, Roadmaster of the Kansas City, Fort Scott & Memphis R. R. has resigned in order to become General Roadmaster of the Panama R. R. His successor will be Mr. A. S. BLODGETT, formerly with the Wabash road.

Prof. H. S. JACOBY has resigned his position at Lehigh University in order to become an Assistant Professor in the College of Civil Engineering of Cornell University, where he will have charge of the department of graphics and bridge engineering. His address will be Quarry and State Sts., Ithaca, N. Y.

Mr. ROBERT DUNBAR, proprietor of the Eagle Iron Works, of Buffalo, N. Y., died in that city, Sept. 18, at the age of 77. He was the inventor of many grain elevator improvements, and builder of the majority of the elevators in Buffalo, as well as designer of many in Liverpool and Hull, Eng., Odessa, Russia, and numerous cities in this country and Canada.

Mr. W. H. ATWOOD, M. Am. Soc. C. E., died recently at his summer home in Chatham, Mass. He graduated from the University of New York in 1871 and immediately entered the engineering profession. He was successively connected with the South Pennsylvania, the Colorado Midland, the Lake Shore & Michigan Southern, and the Cumberland Gap extension of the Louisville & Nashville railways. His specialty was tunneling. His first work in that line was at the Weehawken tunnel on the West Shore R. R. Later he was connected with a number of important tunnels on the South Pennsylvania and the Colorado Midland lines.

NEW PUBLICATIONS.

—*Report of the Chief of the Forestry Division* for the year 1889. Pub. Doc., pamph. pp. 73.

The report bears evidence of elaborate and careful study of the timber supply question, and contains a great deal of useful information; with parts that are of more questionable value.

—*Interstate Commerce Commission Proceedings.*—Relative Rates on Competitive Traffic; pp. 11. In this case the principal point at issue was the right of the defendant, the Western New York and Pennsylvania Ry., to discriminate in favor of oil shippers who used tank cars, and against those who shipped in barrels. The commission emphatically declared that this is unjust discrimination within the meaning of the law, and issued an order for its discontinuance.

Trusses and Arches Analyzed and Discussed by Graphic Methods.—By CHARLES E. GREEN, A. M., C. E. Prof. C. E. Univ. Mich. In three Parts: Part I: Roof Trusses. New York, John Wiley & Sons; 8 vo, pp. 80, 3 folding plates; $1. 25.

This new edition of the first part of Prof. GREEN'S work on graphical statics contains some considerable additions, modifications and rearrangements of material, tending to further improve the work, our favorable opinion of which is sufficiently indicated by the fact that the substance of the work is a reprint of a series of articles originally contributed to this journal. By a most unfortunate oversight of the publishers the three folding plates, which are referred to throughout the volume, have no blank stub to carry them without the limit of the pages so that they can be easily consulted; this defect should by all means be remedied.

Messrs. Julius Bien & Co., of New York, have in preparation an elaborate "*Atlas of the Metropolitan District*," showing New York City and all the adjacent country within 50 miles of it. It will be a series of maps in book form, on a large scale, engraved on copper and printed in colors. The maps will give all the prominent details of the topography and hydrography. The new Census records will be given for all the territory covered by the maps, with other reference matter of the kind. The volume will be 17¼ × 23 ins. in size, and we judge one of the most complete atlases of New York and vicinity yet published.

TRADE PUBLICATIONS.

—*Catalogue of the Berlin Iron Bridge Co.* East Berlin, Conn., 4to pamph., pp. 45.

This particular catalogue is devoted more to roofs than to bridges, of which the company has built a large variety.

SOCIETY PROCEEDINGS.

Western Railway Club.—The first meeting of the season was held Sept. 16. The subjects discussed were: "Relative Cost of Maintaining Rigid Center and Swing Beam Freight Car Trucks, and Comparative Flange Wear of Wheels." Mr. P. H. Peck read a report for the committee, favoring rigid center trucks. He estimated that at least 10% more defects occurred in the swing beam truck than in the rigid beam truck. Defects in swing beam trucks occur generally where wooden transoms are used and hangers are slotted through the transoms. He had not noticed much difference in the flange wear, and considered that badly worn flanges were generally due not to the style of truck but to imperfect side bearings, which not only caused flange wear, but were liable to cause derailment on sharp curves.

Mr. G. W. Rhodes stated that the Chicago, Burlington & Quincy, and its proprietary lines, had abandoned swing beam trucks entirely. As to flange wear, at the Burlington brake tests one train was fitted with rigid beam trucks, and another with swing beam trucks, and the former showed the least resistance in running. The rigid truck weighs less than the swing beam, and costs a little less at the start, and much less for repairs.

Mr. G. W. Cushing said his experience had led him to favor the swing beam truck.

President Hickey instanced the use of swing beams on some engine trucks where the cost of repairs was 40% greater than when rigid beam trucks were used, and the vibration was so great as to loosen the boiler fastenings. His experience corroborated that of Mr. Peck, that flange wear was apt to be due to the side bearings.

The remainder of the discussion was postponed to the next meeting. Officers were elected as follows: President, J. N. Barr, Supt. M. P., C., M. and St. P. Ry.; Vice-Presidents, C. O. Schroyer, Supt. Car Dept. C. & N. W. Ry.; P. H. Peck, M. M. Chic. & W'n., Ind. & Belt. Ry.; Treasurer, Allen Cooke, Gen. M. M. Chic. and E. Ill. Ry.; Secretary, W. Crossman, Ed. *Railway Master Mechanic*, Rookery Building, Chicago.

The next meeting will be held Oct. 21 and a paper on steel-tired wheels and the principles to be followed in fastening tire to center will be read by Mr. G. W. Rhodes.

Railway Master Mechanics' Association.—The following committees have been been appointed to conduct the business of the Association for the coming year, and are to send their reports to Secretary Angus Sinclair before May 1, 1891, in order that the reports may be printed and distributed before the meeting of the convention.

Exhaust Pipes, Nozzles and Steam Passages.—(Investigate best form and size in proportion to cylinders). C. F. Thomas (R. & D., Alexandria, Va.), A. W. Gibbs, L. C. Noble, F. C. Smith, John Y. Smith.

Testing Laboratories, Chemical and Mechanical.—Geo. Gibbs (C. M. & St. P., Milwaukee, Wis.), Philip Wallis, G. W. West, L. S. Randolph, D. L. Barnes.

Advantages and Disadvantages of Placing the Firebox Above the Frames.—Fred. B. Griffiths (D. L. & W. Buffalo, N. Y.), James Macbeth, W. A. Foster, A. G Leonard, Louis F. Lyne.

Relative Value of Steel and Iron Axles.—John Mackenzie (N. Y., C. & St. L., Cleveland, O.), J. S. Graham, John S. Cook, E. B. Wall, Thomas Shaw.

Purification or Softening of Feed Water.—W. T. Small (No. Pac., St. Paul, Minn.), Harvey Middleton, A. W. Quackenbush, J. B. Barnes, John W. Hill.

The Present Status of the Car Coupler Question.—(Investigate whether this Association can indorse the action of the Master Car Builders' Association from a mechanical standpoint in recommending the Vertical Plane Type as a standard.) John Hickey (M., L. S. & Wn. Kaukauna, Wis.), G. W. Rhodes, Sanford Keeler, R. H. Blackall, M. N. Forney.

Examination of Locomotive Engineers and Firemen.—(On their duties relating to the use of fuel, care of the locomotive, and ability to deal with disorder or disability of machinery; to what extent practiced, and best plan for conducting the examination.) W. H. Thomas (E. T., Va. & Ga., Knoxville, Tenn.), John Player, F. D Casanave, J. W. Luttrell, L. R. Pomeroy.

Operating Locomotives with Different Crews.—(Investigate the comparative advantages of operating locomotives with different crews on the "first in and first out" plan, and that of confining men to certain engines, the latter not running a greater number of miles than can be rendered by their regular crews; discuss any improvement in the method of running engines.) Ross Kells, (N. Y., L. E. & W., New York City). W. W. Reynolds, W. F. Turreff, C. G. Turner, John A. Hill.

Locomotive for Heavy Passenger and Fast Freight Train Service.—(Investigate the types best suited for this service, and the relative economy and safety of eight-wheel, ten-wheel and mogul locomotives for the service in question.) Pulaski Leeds (L. & N., Louisville, Ky.), James Meehan, E. M. Roberts, C. E. Smart, W. A. Smith.

Electrical Appliances for Railroad Use.—(Report on the progress of electricity in motive power, car lighting, signaling, welding and kindred uses.)—T. W. Gentry, (R. & D., Richmond, Va.), G. B. Hazelhurst, Albert Griggs, John Ortton, F. W, Dean.

Standards of the Association.—Wm. Swanston, (C., St. L. & P., Indianapolis, Ind.), Wm. Garstang, C. H. Cory, J. S. McCrum, Thomas Shaw.

To Confer with Committee of Master Car Builders' Association on Bringing Conventions Closer Together.—O. Stewart (Fitchburg, Boston, Mass.), Charles Graham, David Clark, G. W. Stevens, John MacKenzie.

On Subjects for Investigation and Discussion.—William H. Lewis (C., B. & N., La Crosse, Wis.), John Wilson, Peter H. Peck.

Executive Committee and Trustees of Boston Fund and Printing Fund.—John MacKenzie (N. Y., C. & St. L., Cleveland, O.), John Hickey, William Garstang, O. Stewart, Angus Sinclair.

ENGINEERING NEWS

AND

AMERICAN RAILWAY JOURNAL.

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GEO. H. FROST.....BUSINESS MANAGER

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Drawings and Photographs *of all new engineering works or designs, large or small, of interest from their magnitude, novelty, or originality, as well as newly adopted* **Standard Plans** *for engineering structures or details, rolling stock, etc., are always desired for early publication. Also* **Brief Technical Notes** *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.* **Letters** *for publication must be accompanied by the name or card of the writer.*

COMING TECHNICAL MEETINGS.

American Institute of Mining Engineers.—International meeting with the Iron and Steel Institute of Great Britain and the Verein Deutscher Eisenhuettenleute as guests. First meeting, Sept. 29, Chickering Hall. Secy., Charles Kirchoff, Jr., 66 Duane St., New York.

Engineers' Club of St. Louis.—Next meeting, Oct. 1. Secy., W. H. Bryan, 30 South 7th St.

American Society of Civil Engineers.—Next meeting, Oct. 1. Secy., John Bogart, 127 E. 23d St., New York.

Association of Civil Engineers of Dallas.—Next meeting, Oct. 3. Secy., E. K. Smoot, Elm and Austin Sts.

Technical Society of the Pacific Coast.—Next meeting Oct. 3. Secy., O. von Geldern, 408 California St., San Francisco.

Engineers' Club of Philadelphia.—Next meeting, Oct. 4. Secy., Howard Murphy, 1122 Girard St.

Civil Engineers' Society of St. Paul.—Next meeting, Oct. 6. Secy., G. L. Wilson.

Western Society of Engineers.—Next meeting, Oct. 7. Secy., J. W. Weston, 230 La Salle St., Chicago.

American Society of Railway Superintendents.—Annual meeting at New York, Oct. 7, at Hotel Brunswick. Secy., C. A. Hammond, 350 Atlantic Ave., Boston, Mass.

Civil Engineers' Association of Kansas.—Next meeting, Oct. 8. Secy., J. C. Herring, Wichita, Kan.

Engineering Association of the Southwest.—Next meeting, Oct. 9. Secy., Olin H. Landreth, Vanderbilt University, Nashville, Tenn.

Civil Engineers' Club of Cleveland.—Next meeting, Oct. 14. Secy., C. O. Palmer, 22 Cedar Ave.

Boston Society of Civil Engineers. Next meeting, Oct. 15. Secy., S. E. Tinkham.

New York Railway Club.—Next meeting, Oct. 16. Rooms, 118 Liberty St.

Engineers' Club of Cincinnati.—Next meeting, Oct. 16. Secy., J. F. Wilson.

Western Railway Club.—Next meeting, Oct. 21. Rooms, Phenix Building, Chicago. Secy., W. D. Crosman, 816 Rookery, Bldg.

Engineers' Society of Western Pennsylvania.—Next meeting, Oct. 21. Secy., S. M. Wickersham, Pittsburg, Pa.

WE give elsewhere a full account of the recent armor tests at Annapolis. The acceptance of their results as absolutely conclusive, and the passage of a bill by the House of Representatives appropriating $1,000,000 for the purchase of nickel for making nickel-steel plates, seems premature. To decide so important a question, especially as to the relative merits of all-steel and nickel-steel, on the tests of a single plate, made under conditions seldom found in service, may possibly lead to serious error.

THE Boston Gas Light Co. deserves much credit for the effort it is now making to popularize the use of fuel gas by offering it to residents of a certain district at 60 cts. per 1,000 ft. When householders have once had a chance to realize the economy and convenience of using gas for cooking and heating in place of coal, they will not readily resign its use, and the company cannot lack for customers at the price stated or less. More important from an engineering point of view is the impetus this reduction in the price of gas should cause in the use of gas engines. This motor, which as now perfected, is a more economical machine than the steam engine, is badly handicapped almost everywhere by the necessity of using high-priced illuminating gas for fuel. With cheap fuel gas, however, we may expect to see the gas engine rapidly increase in importance as a motor, especially for larger powers than have heretofore been common. From the point of view of public convenience, however, no use of fuel gas can be so important as its substitution for coal in household economy. Natural gas has done so much to popularize such use that it only needs a beginning to rapidly extend the use of artificial gas, if it be only sold cheap enough, and the Boston experiment has therefore special significance.

OUR readers will remember that in a recent issue (Aug. 2) we published in full an article from the London *Engineer* as to "English and American Boiler Practice," in which that journal advanced certain opinions and queries of its own, and called upon this journal by name to accept or refute them. This we did in the same issue, in the only spirit in which a rational being cares to carry on scientific discussion, that of perfect impartiality. So far as the *Engineer's* positions seemed correct, we frankly admitted them. With equal frankness, and equal fairness, the important respects in which its positions appeared wholly incorrect, and in one or two instances absurdly mistaken, were also pointed out.

It is doubtless hard for any journal to print in its own columns an exposure of its own errors, but justice and courtesy alike require that a reputable technical journal should give either a full reprint or fair abstract of answers to its own questions in a discussion of its own seeking. What is our astonishment, therefore, to find in the *Engineer's* last issue what can only be described as a garbled and systematic misrepresentation of the whole of our argument, all reference to all the more important points scored against it being wholly suppressed. For example, it suppresses entirely our exposure of its absurd error in alleging that brick arches could not be used except with copper fire-boxes, were not used in this country, and were a probable explanation of the alleged difference in evaporative efficiency of locomotive boilers. On this important point it simply makes the incorrect statement that "our contemporary rejects the idea that the presence or absence of the brick arch has anything to do with the matter." Similarly, it discreetly ignores our exposure of its error in claiming for the locomotives, which it so zealously champions, a working maximum of 10 lbs. per pound of coal evaporation, as to which we said: "The locomotive never ran in England, nor in the world, which, as an average of a year's service, or even 1,000 miles' service, could show such an evaporation. We challenge our contemporary to give evidence to the contrary. The proof does not exist."

AFTER quoting at some length some remarks which pleased it as to the notable difference between the soft exhausts of English locomotives and the "sharp tearing cough" of the usual American exhaust—stopping just short of the explanation why the difference exists—our contemporary remarks: "It is really an enjoyable thing to discuss locomotive performances with our contemporary, because he so frankly concedes point after point." We can well believe it. There was never yet a tricky man dealing with an honest one, who did not find the latters "frankness" uproariously funny. There is but one drawback to such hilarity, it does not last long, only till the roguery of the second party is found out. Then, the honest man simply drops him in disgust, as we are compelled to drop the *Engineer* as a technical antagonist. It remarks, apropos of a statement which would otherwise invite some comment, that in England they run trains "of 200 to 250 tons" at over 50 miles per hour with one locomotive. "Our contemporary must not think us troublesome if we ask for data concerning an American railway which works a heavier passenger traffic than may be met with any day in England." We do not think you troublesome, contemporary, we think you unfair and your question therefore will go unanswered. What can be more thoroughly unfair than to publish this passage as a summary of the conclusions reached in our article of August 2?

The results, according to our contemporary, may be summed up so far thus: (1) American locomotive coal is inferior to English coal; (2) the American fireman is inferior to the English firemen; (3) the haulage of heavy trains at slow speeds renders necessary the use of contracted exhaust nozzles, which cause much waste by creating back pressure, and tear the fire to pieces; (4) the haulage of heavy trains at slow speeds costs 20% more in fuel than would the haulage of lighter trains at higher speeds; (5) the defects of the American locomotive are the result of the conditions under which it is worked, not of defects in design or construction, or in want of adaptability to the work it has to perform. This seems to be our contemporary's thesis and we commend it to the consideration of our readers. *It seems to us a curious admission that American engineers are unable or unwilling to make locomotives which shall be up to their work. That is what our contemporary's positions come to after all.*

SIMILARLY, we said as to our contemporary's suggestion of a difference in quality of coal: "A general average of the entire country includes much coal of a very inferior quality, having only 75 to 80 per cent. of combustible, used because it is so abundant and cheap. This statement *The Engineer* perverts and distorts in the following dishonest fashion (*italics ours*):

As it has always been claimed up to the present that American coal is rather better *on the whole* (all italics ours) than English coal, and that American firemen were, *as a matter of course*, superior to English firemen [By whom has either of these claims been made? ED.] we have been driven to the conclusion that the boiler must be to blame; and we believe that the weak place was probably the absence of the brick arch, and that the brick arch was not used [no admission that it is used] because its presence caused the cracking of steel fire boxes, and American locomotive builders would not put in copper boxes. It seems that on *two* points we were in error. In the *first* place, American coal is not as good as English coal; *it is poor stuff, "containing only 75 to 80 per cent. of combustible."* Sea-going engineers say they know by bitter experience that American coal is a very different fuel from English coal; but we have hitherto been disposed to regard this as insular prejudice. It seems, however, that prejudice has very little to do with the matter. In the *second* place we learn with astonishment that the American fireman is not comparable to the English fireman in skill. [Here follows a quotation from our columns ending with "We judge the difference in firemen to be good for 5 per cent. of the fuel, possibly more."] In this country the difference between *a good and a bad fireman* is much more than 5 per cent."

The total distortion of what we said as to the comparative quality of both coal and firemen will be seen at once, as also the *suggestio falsi* (to put it mildly) as to there being only two points on which it "seemed that *The Engineer* was in error." Nor can our contemporary escape on the plea that it is recording only what "seems" to itself, and admits no other error. The extract above distinctly purports to be an abstract of our argument on the question.

Railway Construction in the Southwest.

The map and statistics of railway construction which we present with this issue of ENGINEERING NEWS show that a considerable amount of new railway is being built in the Southwest, especially in certain sections, and that the prospects

ENGINEERING NEWS
SERIES OF MAPS: No. 28
SOUTH-WESTERN STATES.

TRACK LAID DURING 1889
TRACK LAID SINCE JAN. 1, 1890
LINES UNDER CONTRACT OR CONSTRUCTION
LINES SURVEYED OR UNDER SURVEY
PROJECTS OF SOME PROMISE

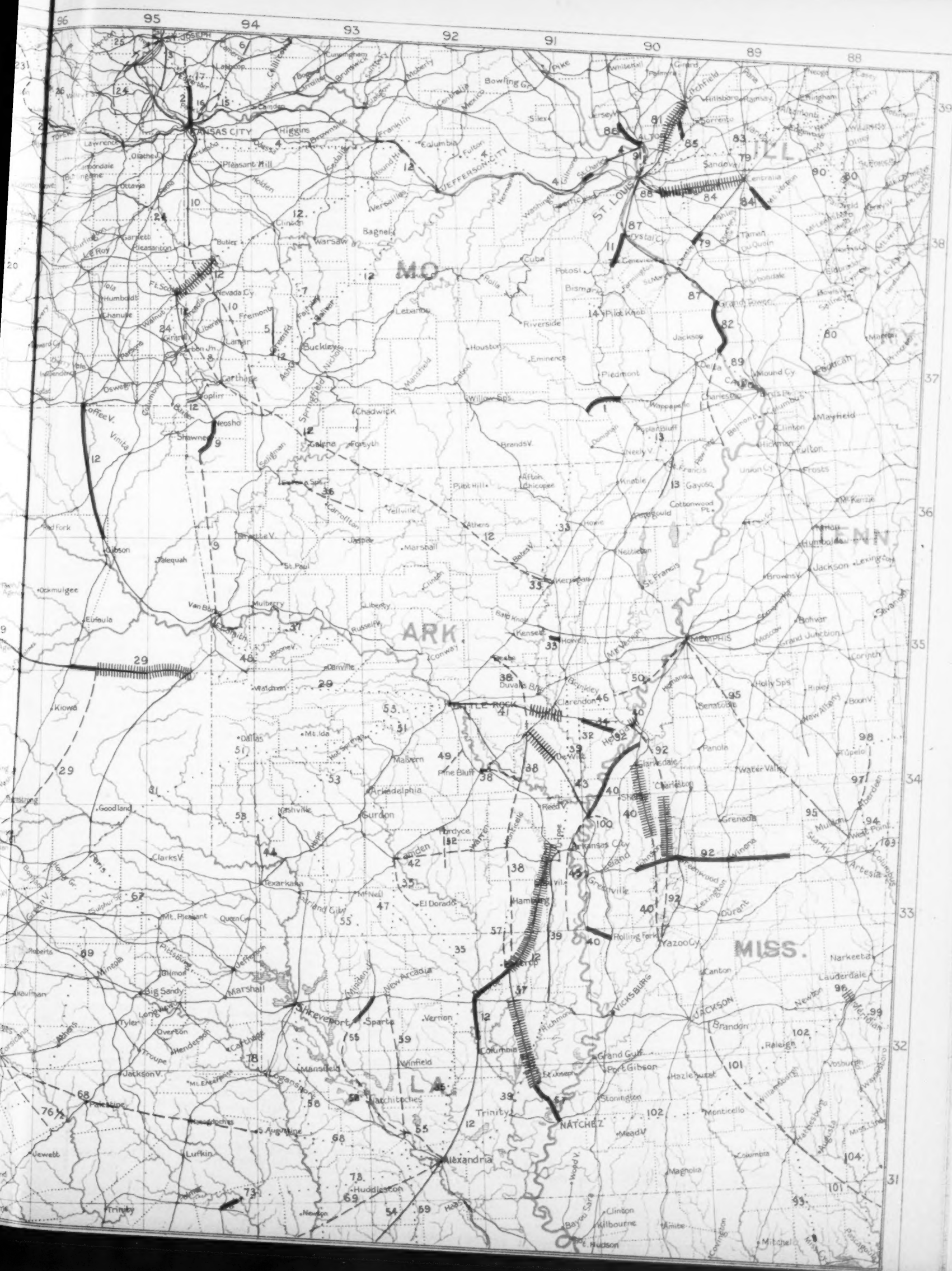
Figures refer to accompanying list.
Lines having the same numbers are controlled in the same interest.

Last preceding issue of this map was on Sept. 28, 1889.

50 Miles to 1 Inch.

COL. KAN. NEW MEX. TEX. IND TER. OKLAHOMA PUBLIC LANDS CHEROKEE OUTLET

DENVER, Byers, River Bend, Colby, Norton, Smith Co, Manhattan, Washington, Greenleaf, Marysville, Junction, Clifton, Wallace, Buffalo, Waldo, Ellis, Hays, Salina, Ellsworth, Kansas Junction, Manitou Jn, Wit Carson, Pueblo, La Junta, W. Las Animas, Carlton, Scott, Ness City, Great Bend, Ellinwood, McPherson, Barton, Eldorado, Cucharas, Lakin, Dodge C. N., Kinsley, Larned, Montezuma, Bucklin, Wichita, Trinidad, Hoehne, Aroro, Ashland, Liberal, Medicine, Attica, Caldwell, Kiowa, Winfield, Arkansas City, Hunnewell, Reton, Wellington, Summer, Douglas, Augusta, Elmdale, Florence, Strong City, Cottonwood, Emporia, Burlington, Ottumwa, Iola, Chanute, Parsons, Oswego, Independence, Coffeyville, Cherryvale, Kansas City, Olathe, Lawrence, Topeka, Atchison, Leavenworth, Junction City, Manhattan, Abilene, Salina, Ellsworth, Wichita, Hutchinson, Newton, Peabody, Florence, Eldorado, Augusta, Winfield, Arkansas City, Ponca, Pawnee, Guthrie, Oklahoma, Purcell, Ft. Sill Kiowa & Comanche Agency, Ft. Cobb, Wichita Agency, Ft. Arbuckle, Ardmore, Gainesville, Denison, Sherman, Whitesboro, Bonham, Paris, Clarendon, Chillicothe, Vernon, Wichita Falls, Jacksboro, Decatur, Denton, Fort Worth, Dallas, Corsicana, Hillsboro, Waco, Temple, Cleburne, Alvarado, Weatherford, Albany, Abilene, Cisco, Eskota, Colorado, Big Spring, Midland, Ft. Chadbourne, Ballinger, Coleman, Brownwood, Morgan, Mexia, Antelope Gap, Gatesville, Lampasas, Brady, San Angelo, Pecos, San Martin, Ft. Bascom, Tucumcari, Panhandle City, Higgins, Buffalo Sp. Sta., Baker's Sta., Kingfisher, Cheyenne & Arrapahoe Agency, Oklahoma, Paoli, Watrous, Las Vegas, Romeroville, Wagon Mound, Ft. Sumner, Socorro, Albuquerque, Santa Fe, Lamy, Glorieta, Pecos, Rowe, Tecolote, Las Vegas, Romeroville, Wagon Mound, Ft. Sumner, Socorro, Albuquerque, Santa Fe, Lamy, Glorieta, Pecos, Rowe, Tecolote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ST. JOSEPH
KANSAS CITY
Higgins
Pleasant Hill
Holden
Clinton
Warsaw
Bagnell
JEFFERSON CITY
Columbia
Fulton
Mexico
Centralia
Sandoval
ST. LOUIS
Crystal Cy
Cuba
Potosi
Rolla
Bismarck
Pilot Knob
Ironton
Arcadia
Lebanon
Riverside
Houston
Eminence
Piedmont
Jackson
Cape Girardeau
Mound Cy
Paducah
Marion
Harrisburg
Carbondale
Chester
Sparta
Chadwick
Willow Springs
Mansfield
Buckley
Fremont
Nevada Cy
Carthage
Joplin
Neosho
Shawnee
Galena
Forsyth
Springfield
Marshfield
Ash Grove
Lamar
Barton Jn.
Granby
Liberal
Fairfield
Fairview
Walnut Grove
Chanute
Humboldt
Fl. Scott
Iola
Le Roy
Pleasanton
Butler
Harrisonville
Lawrence
Olathe
Ottawa
Osawatomie
Ossawatomie
Paola
Lansdale
Gardner
Edgerton
Franklin
Brownsville
Cedar
Round Hill
Versailles
Tipton
Otterville
Syracuse
Sedalia
Green Ridge
Smithton
Hughesville
Warrenton
Washington
Hermann
Gilmore
St. Charles
Wentzville
Troy
Lincoln
Bowling Gr.
Pike
Whiteford
Palmyra
Girard
Litchfield
Hillsboro
Raymond
Farmington
Ste. Genevieve
Perryville
Jerseyville
Alton
Godfrey
Edwardsville
Collinsville
Belleville
Centreville
Ashley
Tamaroa
DuQuoin
Carbondale
Elkville
Anna
Jonesboro
Cairo
Thebes
Olive Br.
Cape Girardeau
Bloomfield
Dexter
Kennett
Hayti
Caruthersville
Portageville
Sikeston
Charleston
Morehouse
Bernie
Malden
Poplar Bluff
Neely's Landing
Wappapello
Williamsville
Greenville
Fredericktown
Ironton
Arcadia
Belmont
Columbus
Hickman
Fulton
Mayfield
Clinton
Wickliffe
Cairo
Metropolis
Golconda
Harrisburg
Eldorado
Shawneetown
Equality
Carrier Mills
Marion
Herrin
Carterville
Murphysboro
Du Quoin
Pinckneyville
Sparta
Chester
Red Bud
Waterloo
Columbia
Hecker
Belleville
Lebanon
Mascoutah
Centreville
Cahokia
East St. Louis
Granite City
Alton
Godfrey
Edwardsville
Glen Carbon
Collinsville
Maryville
Troy
Wentzville
Lake St. Louis
Wright City
Warrenton
Washington
Hermann
Gilmore
St. Charles
Florissant
Ferguson
Kirkwood
Webster Gr.
Manchester
Ballwin
Valley Park
Eureka
Pacific
Union
Washington
Gray Summit
Sullivan
Cuba
Rolla
Bismarck
Pilot Knob
Ironton
Arcadia
Farmington
Ste. Genevieve
Perryville
Jackson
Cape Girardeau
Bloomfield
Dexter
Kennett
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ARK.
MISS.
LA.
Vinita
Coffeeville
Oswego
Columbus
Girard
Pittsburg
Mulberry
Van Buren
Fayetteville
Springdale
Rogers
Bentonville
Siloam Spgs.
Gentry
Decatur
Gravette
Gentry
Maysville
Prairie Grove
Huntsville
Eureka Spgs.
Berryville
Green Forest
Harrison
Yellville
Flippin
Mountain Home
Salesville
Cotter
Gassville
Calico Rock
Batesville
Melbourne
Ash Flat
Pocahontas
Corning
Piggott
Paragould
Jonesboro
Lake City
Marked Tree
Osceola
Blytheville
Manila
Leachville
Monette
Rector
Walnut Ridge
Hoxie
Newport
Augusta
Cotton Plant
Wynne
Forrest City
Hughes
Marianna
Helena
West Helena
Lexa
Marvell
Barton
Elaine
Dumas
McGehee
Lake Village
Eudora
Crossett
Hamburg
Fountain Hill
Monticello
Dermott
Lake Providence
Tallulah
Vicksburg
Delta
Rayville
Oak Grove
Bastrop
Monroe
West Monroe
Ruston
Farmerville
Bernice
Minden
Homer
Haynesville
Springhill
Mansfield
Logansport
Many
Natchitoches
Leesville
Jena
Winnfield
Winnsboro
Harrisonburg
Tallulah
Vicksburg
Delta
Rayville
Oak Grove
Bastrop
Monroe
West Monroe
Ruston
Farmerville
Bernice
Minden
Homer
Haynesville
Springhill
Mansfield
Logansport
Many
Natchitoches
Leesville
Jena
Winnfield
Winnsboro
Harrisonburg

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for future activity are good. The following table gives by States the mileage now in the various stages of construction:

STATES.	Track laid.		Under contract or construction	Located and under survey.	Projects of some promise.
	In 1889.	To date in 1890.			
Mo.....	101.56	38.88	268	397	625
Kan.....	58.7	50.01	85	101	742
Ind. Ter..	163.68	82.11	159	256	447
Ark.....	19.	99.35	163	716	912
La	119.66	113.25	306	308	845
Tex...	274.3	140.	475	828	1,450
Total.....	737.9	523.6	1,407	2,606	5,051
Last yr. same date		417.	1.203	1.563	4,834

From this it appears that Texas continues in the lead, both in length of track laid, mileage under construction and mileage surveyed and projected for future construction. Louisiana, Arkansas and Indian Territory follow Texas in the order named, each showing a large amount of work in progress and a considerable increase in activity over last year. Kansas and Missouri have more work under way than at the same date last year, but nothing approaching the amount in progress in 1887 and 1888. In general the outlook for new construction in this section of the country may be considered more favorable than it was a year ago. The present totals of mileage in the various stages of progress as compared with those accompanying the last preceding issue of our map of this section are shown above and in the following table:

	Track laid.	Under construction.	Under survey.	Projected.
Sept. 28, 1889.....	417	1,203	1,563	4,834
Sept. 27, 1890.....	524	1,407	2,606	5,051
Increase, 1890.	107	204	1,043	217
" per ct.	25.6	17.0	66.7	4.5

These totals need to be studied in connection with the detailed list of new lines, however, before correct conclusions can be drawn. It will be seen from the latter that the companies operating the great railway systems of the Southwest are, with one exception, still holding aloof from any extensive new construction. Nearly all the work in progress is being done by independent companies, and most of the new lines are located in the timber and coal regions, where the local traffic is capable of furnishing a paying business for the roads from the first. Many of these companies, it is true, have a large mileage of projected lines, and are aiming toward a more extensive through business in the future; yet in nearly every case a disposition to build lines only where the way is clear to a fair business as soon as the road is opened, is shown in their present construction.

This same conservatism is noticeable in the extensions now being built by the Missouri Pacific Railway, the only one of the large companies which is doing any amount of construction. Its most important work is the extension from Brinkley, Ark., to Alexandria, Mo., being built under the name of the Houston, Central Arkansas & Northern R. R. This road has already been completed from Columbia, La., to McGehee, Ark., 123 miles, and work has just commenced on a further extension south to Alexandria, La. For the entire distance the line runs through the pine timber lands of northern Louisiana and the mineral region of southeastern Arkansas. The company's other extensions are located in the southern portion of Kansas and Missouri, penetrating the region tributary to Ft. Scott, Kan., and consist of short lines connecting that place with one of the main lines of the system at Rich Hill and Webb City. Surveys have just been begun, also, for the line from Carthage, Mo., to Batesville, Ark., connecting the company's Missouri and Arkansas systems.

None of the other great companies of the Southwest have any construction in active progress. And this is not at all strange in view of the financial history of Southwestern railways during the past two years. With the exception of the Atchison system, where peculiar conditions affect the results, the prosperity of the railways in this section has not been such as to inspire or enable very large outlays in new construction.

It seems evident that the era of aggressive railway building in this section is at an end. Nowhere is this more observable than in the States of Missouri and Kansas, and especially in the latter. Neglecting the Missouri Pacific lines, which have already been mentioned, construction is in progress on only two lines in Kansas, the Omaha, Hutchinson & Gulf, and the Topeka, Westmoreland & Marysville. The Kansas City, Wyandotte & Northwestern, which has been absorbed by the Gould system, has a projected line of considerable importance from Carbondale to Wichita, but there is little likelihood of any work being done on it for some time. Further east the Chicago, Kansas & Nebraska has a line projected and partly surveyed from St. Joseph to Joplin, Mo., 256 miles. Among the enterprises of less moment, the Omaha, Garden City & Southwestern still preserves its organization, and with the old Dodge City, Montezuma & Trinidad is waiting for better times to complete its line.

In Missouri the Missouri Pacific has several extensions projected and surveyed, and the Cleveland, St. Louis & Kansas City and the Greenfield & Northern have lines partly graded upon which it is hoped to be able to resume work soon. In the northwest the Chicago, St. Paul & Kansas City is rapidly grading its line from St. Joseph to Leavenworth, Kan., 23 miles, and further south the Kansas City, Nevada & Fort Smith has succeeded to the franchises of the old Kansas City, Rich Hill & Southern, and is grading on a line from Kansas City south. Several other lines of minor importance are projected in the vicinity of Kansas City.

Work in Indian Territory is confined to two lines. The Chicago, Rock Island & Pacific has finished during the year an extension of its line across the territory and has completed surveys to the Red River, but work is discontinued for the present on account of difficulty in obtaining right of way across the government lands. The most important enterprise in the Territory, and probably the largest independent enterprise in the Southwest is the Choctaw Coal & Railway Co. This company, which is backed largely by Pennsylvania capitalists, some of whom are stockholders of the Lehigh Valley R. R., proposes to build a road from Little Rock, Ark., west across the territory to a connection with the Texas Panhandle system, with a branch through the coal lands in the southeastern part of the territory to Denison, Tex., a total distance of nearly 800 miles. About 65 miles have already been completed, and an additional section of 150 miles is now under construction. It seems probable that this division with the branch to Denison, will be completed soon. The line penetrates the most fertile agricultural lands in the territory, and opens up the bituminous coal fields of the southeastern portion to Texas and the Gulf cities.

Nearly all of the work in Texas is confined to the eastern section of the State, and a considerable of it is south of the limits of our map. The most noticeable feature in the section which we show is the development of Dallas and Fort Worth as railway centers. From both of these cities lines are projected west into the coal fields and grazing lands and east into the pine timber regions of Texas and Louisiana. The most important of these lines are the Ft. Worth & Rio Grande, which is building from Fort Worth southwest to the Rio Grande River; the Sherman, Denison & Dallas, 90 miles long, connecting the cities named in its title; the Red River, Sabine & Western, projected and partly surveyed from Fort Worth to Alexandria, La., about 305 miles, and the Gulf, Brazos Valley & Pacific, under construction and partly surveyed from Henrietta along the valley of the Brazos River to its mouth, a distance of 400 miles. Of the less pretentious enterprises the Wichita Valley and the Weatherford, Mineral Wells & Northwestern are worthy of note. The former is rapidly constructing a line from Wichita Falls southwest along the valley of the Wichita River, and the latter has a short line under construction between Weatherford and Mineral Wells, 18 miles. Two enterprises of large ambitions, but limited cash, are the Ft. Worth & Albuquerque and the Dallas, Pacific & Southeastern, projected from Fort Worth and Dallas, respectively, to Albuquerque, New Mexico. Both companies have partly graded short extensions west into the coal fields of Jack and Archer counties, and may lay track this year.

The San Antonio & Aransas Pass system, which has done so much building during the last three years, has defaulted on its bonds and is now in the hands of a receiver. Its extension to Waco is nearly completed and probably will be finished soon. Of its other extensions shown, the branch from Houston to Alexandria, La., 225 miles, has been surveyed and a line is projected from Waco to Paris, 200 miles. It is not probable that work will commence on these for some time. The other projected extensions of the system are south of the limits of our maps, but will be discussed along with other projects in southern Texas in connection with our map of the Pacific States, to be published soon.

In Louisiana activity is confined chiefly to the northern timber region with Alexandria as its center, a fact most strikingly shown by the map. From this point lines are projected north into Southern Arkansas and west into Texas, penetrating the vast pine timber lands of those States, and connecting the railway systems of Arkansas and Louisiana. The most noteworthy are the New Orleans & Northwestern, partly completed and under construction from Natchez, Miss., to Hamburg, Ark., 137 miles, and the Camden & Alexandria, the Louisiana & Northwest, and the Louisiana, Arkansas & Missouri, running from Alexandria, north 175 miles, 225 miles, and 280 miles, to Camden, Hope and Brinkley, Ark., respectively. Of the two last mentioned, the Louisiana & Northwest has its line completed from Homer to Bienville, 35 miles, and construction is in progress on a portion of the Louisiana, Arkansas & Missouri. The Camden & Alexandria will probably also commence work on a portion of its line soon. South from Alexandria a line is under construction to Lake Charles, 105 miles, by the Kansas City, Watkins & Gulf Co. The New Orleans, Ft. Jackson & Grand Isle is the only line upon which work is in progress in the southern portion of the State. This company is building south from New Orleans to Fort Jackson and Grand Isle on the Gulf coast, a distance of 80 miles. The road is a local enterprise projected to afford the sugar planters an outlet for their products.

Very little work is being done in northern Arkansas, but in the southern and southeastern parts there is considerable activity. Many of the lines in this section have already been mentioned. Of the others, the Mississippi & Little Rock's extension to Little Rock, 61 miles; the extension of the St. Louis, Iron Mt. & Southern to Camden, 45 miles; the Stuttgart & Arkansas Post, and the Kansas City, Arkansas & New Orleans are the most important. Two lines are projected west from Little Rock to the Indian Territory line and the Kansas City, Ft. Smith & Southern has an extension surveyed south 100 miles from Splitlog, Mo. Among the enterprises of more modest proportions may be mentioned the Batesville & Brinkley, the Eureka Springs, and the Texarkana & Northern extensions. Work is slowly going forward on the last.

Viewing the progress in the Southwest as a whole, it is probable that construction is quite as active at the present time as the healthy growth of the country will warrant. Social and political causes have combined to retard the industrial growth of this section of the country, and it is only

within the last few years that the development of its great natural wealth has commenced. With this a corresponding development in the transportation business is sure to follow. And while the traffic resources of the region must always be less than those of a manufacturing or grain growing section, the very inadequate railway facilities in proportion to the traffic will make it one of the chief centers of railway construction for many years to come.

Notes in Bay City.

[EDITORIAL CORRESPONDENCE.]

The traveler who enters Bay City by the Michigan Central cannot fail to have a favorable impression of the place at the start, for the magnificent new station which has just been opened there by the Michigan Central is one of the finest, both in architecture and in comfortable appointments, of the many model stations upon that road. Its surroundings, indeed, are not all that could be desired; but that matter will doubtless remedy itself at an early day, for a fine passenger station is very apt to bring about the construction of fine hotels and business houses in its vicinity.

Bay City and its rival across the Saginaw River, West Bay City, the two together forming practically one community, have had about as genuine a boom during the past few years as any town in this section. Probably the excellent harbor facilities have much to do with the rapid growth in population and prosperity.

Just now the principal topic of conversation is the successful launch of a steel steamer for traffic on the Atlantic seaboard from the ship yards of F. W. Wheeler & Co., at West Bay City. The steamer is 275 ft. in length, considerably too long to pass through the locks of the Welland Canal. She is therefore to be taken to Buffalo, where she will be cut in two amidships; a bulkhead will be put in each end, and each half will be towed through the canal. It is indeed an achievement of which Bay City may well be proud, that a ship yard at this far inland port should undertake the construction of steel vessels for ocean traffic in competition with the long-established yards on the Atlantic seaboard.

THE INDUSTRIAL WORKS.

This establishment is doing a large business in cranes, transfer tables, etc., as well as in the line of wrecking cars, steam shovels and similar tools, in which they have a wider reputation. In traveling cranes, a type which seems quite popular is driven by a wire rope running along one of the tracks and guided by idle wheels to encircle half the circumference of the driving pulley on the crane. One of these cranes, now nearly finished, has a span of 50 ft. and will carry a load of 15 tons.

For driving transfer tables electric motors seem now to be by far the most popular. The works now have orders for one 40-ft. and three 70-ft. electric transfer tables for the Chicago, Burlington & Quincy, for which they will furnish the plant throughout.

The increase in the weight of rolling stock in the past few years has necessitated a corresponding increase in the weight of wrecking cars. Thirty-five tons capacity is the size now commonly called for. This wrecker is built on a 12-wheeled car, two 4-wheel trucks being placed under the end on which the crane stands and the load is distributed equally to each truck by heavy I beams. The cars for cranes, wreckers, shovels, etc., are built throughout at the works, with the exception of springs, wheels, and crane chains.

The establishment is justly proud of the distance to which it sends some of its machines. Two steam shovels have recently been furnished to the Nicaragua Canal Co., and a steam pile driver has been sent to the Panama Railroad.

The works are using crude oil under the boilers with much satisfaction, but do not use it elsewhere. Probably the blacksmiths' prejudices in favor of soft coal for forge fires are too strong to be overcome. On general principles oil fuel is of greater advantage in metallurgical work, since the heat can be concentrated and regulated with such facility, and there are no ashes, cinders or smoke.

One of the most interesting things about the establishment was a little four-wheeled crane with which two men were unloading iron in the yard. The crane was self-propelling, and was run up alongside a loaded gondola. One man on the car adjusted a sling around a ton or so of channel iron and the crane swung it lightly up and around and deposited it on a push car to be run into the shop. The amount of material which two men with this little machine will handle in a day is astonishing. It is self-propelling, so that it can be run wherever it is needed, and heavy material is handled not only much more economically but with less injuries to the men employed.

It is seldom realized how crude and expensive are the methods of handling heavy freight generally in use in this country, with the exception, of course, of bulk freight like grain, coal and ore. In the use of cranes for loading and unloading freight English practice is much ahead of American—a somewhat strange anomaly, since in this country, where labor is expensive, the saving to be made by the use of machinery is so much greater.

THE MICHIGAN PIPE WORKS.

Probably most engineers who have to do with water-works construction are of the opinion that wooden mains are a cheap and temporary substitute for iron in the construction of water-works. A very different opinion on this matter prevails at the works of this company, which is located on the water front not far from the Michigan Central station.

The process of manufacture of this pipe is extremely interesting. The timber used is the clearest and soundest of white pine, of which, notwithstanding the extent to which the forests have been cleared, a large amount still remains in northern Michigan. The logs are sawed into 12-ft. lengths, and are then taken to a large lathe, where the bark and outer layer of wood are taken off and the log is turned down to a true cylinder. It is then ready for boring. This is done by large ring-shaped bits, which leave the core for use in making pipe of a smaller size. Thus a 16-in. log may make a pipe of 11 ins. interior diameter and leave a 9-in. core. From the latter may be made a pipe of 5 ins. inside diameter. The pipe is then taken to a reamer, which enlarges the bore at each end to a depth of about 5 ins., so that the joint piece may be inserted at the proper time.

The "shells," as they are called, are thoroughly seasoned, both in a hot blast dry kiln and in the stock room, where they are piled until wanted for use. The shell is then placed in a lathe and wound with inch-wide hoop iron. No. 14 iron is used for 3-in. pipe and heavier sizes on larger pipe. This iron is first coated with coal tar pitch, and is wound on the shell by a machine which gives it considerable tension.

The pipe then rolls along to the testing machine, which is like those used for testing cast iron pipe, where it is subjected to a pressure of 180 lbs. to the square inch. If no leaks appear after this pressure is sustained for some time, the pipe goes forward to be coated. This is done by a series of rolls which dip in a bath of melted pitch as they revolve and thoroughly coat the exterior of the pipe. To give this coating a "body" and make it less liable to injury in handling, the pipe is then rolled over a bed of coarse sawdust. It is then given another roll on the tar rollers and a final coat of sawdust, a coupling piece is driven in at one end, and it is ready for use.

Probably in the fact that the coating is applied to the exterior only is to be found one secret of the durability of this pipe. The water thoroughly permeates the wood, which is thus placed in the same condition as wood immersed in water. About 3,000 ft. of 6-in. pipe laid in Bay City 16 years ago was taken up recently to lay a larger main. Every length of this pipe was tested to 160 lbs. pressure and was found perfectly tight. The wood was as thoroughly sound as when laid. On cutting pieces of the pipe the pitch in the wood was as evident as if the timber had been recently felled.

The cost of this pipe is nearly equal to that of cast iron mains of the same diameter, but it can be laid so much more rapidly and cheaply than the cast-iron pipe that the cost per mile of mains laid is 20% to 25% less than cast iron. The lengths need only to be driven together, as the swelling of the seasoned joint pieces makes a water-tight joint.

The advantages of the pipe over cast iron are that mains of small diameter do not choke up with tubercles, but keep their original capacity. For mine use, to carry water impregnated with acids, or in any place where water containing corrosive substances is to be carried, the pipe is especially adapted. From 60 to 80 miles of mains per year is the annual output of the works, for winding which over 600 tons of hoop iron is required.

Another use to which wood pipe is put is to cover the steam mains used for steam distribution in city streets by the Holly system. For this purpose shells 17 ins. in internal diameter were recently furnished to the steam company operating in Denver, Col.

Besides water mains, the company make wooden well tubing, simply a square stick with a 2-in. hole bored through its center. The boring auger leaves the interior of the tube quite rough, and to smooth it a polished iron shaft of the exact diameter of the tube, revolving at high speed, is run into the bore. The friction smooths the interior of the tube and leaves it perfectly clear of slivers or splinters.

A SALT FACTORY.

In the process of turning the logs and boring the pipes a great amount of shavings and sawdust is made. This is carried by belt conveyers to the boiler room, and it makes steam sufficient to run the mill engines twice over. Within 10 ft. of the boiler room is a salt well, from which a pump brings up a steady stream of brine. This is evaporated by the surplus steam from the boilers. A more striking case of a waste product in the right place for utilization, it would be hard to find.

The salt well is about 900 ft. deep, and the brine is of excellent quality. The output is about 125 barrels of salt per day.

CORRESPONDENCE.

Charring Piles Before Creosoting.

WILMINGTON, N. C., Sept. 22, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: The subject of preserving piles in the waters of our southern coast is one that is of prime importance to engineers engaged in subaqueous constructions in those regions where the ravaging teredo exists. The writer has become convinced that whatever antiseptic is used to resist the invasion of this destructive insect, piles before being treated otherwise should first be thoroughly charred. The destructive temperature to which the exterior of the pile is subjected in the process of charring, kills all germ life existing in the green wood, opens the pores to the absorption of the antiseptic and surrounds the log with an armor that, so long as it lasts, is impenetrable to the teredo because of the destruction of the nutritive upon which the worms thrive. The perfectly sound condition of the piles in the government wharf in Charleston harbor, which were charred and cresoted in the year 1883, is a striking proof of the efficacy of this process. It should be remembered that untreated piles are eaten completely through at Charleston in less than two years by the ship worm. The Nicaragua Canal Construction Co. have become convinced of the value of charring and have given orders to char all the piles being prepared for the Greytown harbor work at the Wilmington cresoting works.

Very truly yours,

WM. KENNISH,
Engineer, Carolina Oil and Creosote Co.

[The contents of this note coming from the source they do, are well worthy of the attention and remembrance of engineers.—ED. ENG. NEWS.]

Practice in Railway Location.

PITTSBURG, Pa., Sept. 21, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: Referring to the bit of location illustrated in your issue of Sept. 13, you state that the error shown by the same is a very common one. Is this not a sad commentary upon the ability of our American engineers, especially as we as a nation are continually vaunting the superiority of our railway system. I certainly concur in your statement, for it is a self-evident fact that about nine-tenths of the locations of American railroads are a standing disgrace to the engineering profession. This, the most important part of railroad work, is generally intrusted to men who are tyros, mere beginners, under the delusion that any one who can run a transit can locate a railway line. I venture to say positively that the line mentioned by Mr. C. O. Foss was located by the pernicious "practiced eye" method, so favorably looked upon by so many so-called engineers. It is extremely difficult to run in a long curve on the ground without first projecting it on paper. By the "practiced eye" the result is a series of short curves, connected by short tangents, the line thus located following closely the contour of the ground, and the profile of which when plotted shows easy work, obtained at a great sacrifice of alignment, and of course to

the detriment of the future operation of the road. If the promoters of railways would have a line located first and then built, instead of doing the reverse, as is generally practiced, a great saving to the men who put their money in the enterprise would be the result. But it seems to be the belief of railway managers that every cent spent for engineering is just so much money thrown away, which might be placed to more advantage otherwise. So long as the present method is continued of sending out a party, running in locations at so much a day, without any regard to whether a better line could be obtained, and then following with all haste with the construction, just so long will we continue to see examples of the kind of locations illustrated in your paper. ELI MEWOL.

The Strains in Curved Masonry Dams.

LONDON, Aug. 27, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: The paper on the Strains in Curved Masonry Dams by Messrs. VISCHER and WAGONER, noticed in ENGINEERING NEWS of March 15, 1890, is probably the most ambitious attempt to thoroughly investigate the equilibrium of curved dam that has yet been made. The authors do not, however, make any attempt to treat the question generally, but have confined their work to that most remarkable structure, the Bear Valley Dam. This dam, illustrated in ENGINEERING NEWS for April 7 and June 23, 1888, is of trapezoidal section, being 3.2 ft. wide at the top and 8 ft. 6 in. wide at the bottom. Its height is 48 ft. and its mean radius is about 337 ft., while it subtends an angle of only 42.5°. By the ordinary theories as applied to straight dams, this structure should have failed as soon as any attempt was made to fill the reservoir behind it, but for 5 years it has withstood the pressure of a full reservoir without showing the slightest sign of failure.

The authors of the paper under consideration have made several attempts to explain the abnormal strength of this dam. In the first instance they considered it as divided up into a series of vertical strips, each of unit width. They then supposed that each of these strips resisted the water pressure on it partly as a similar strip of a straight dam would do, and partly by the help it received from the horizontal layers of the dam. In making the calculations it was assumed in the first instance that the strip received no assistance from these horizontal layers, and the deflection of various points on its vertical height were calculated. Then it was assumed that the final shape of the horizontal layers would be a pair of circular involutes, and on this assumption the resistance of each of these layers was calculated for the deflections of the different points of the vertical strip. A second calculation was then made as to what the deflections would be if the forces acting on the strip were the water pressure and the above-mentioned resistances of the horizontal layers, and a second approximation to the true deflection of the strip was thus attained. Proceeding in this way by successive approximations, the authors finally arrived at the result that the moment at the bottom of the dam would be about 19% less than if the dam was straight, an amount totally inadequate to account for the stability of the structure. The methods adopted, it will be seen, are tentative, and this course was probably the best, as the direct method of solution would have involved solving 10 simultaneous equations.

The authors accordingly abandoned the assumption as to the form of the horizontal layers, and the next 26 pages of the paper are devoted to an investigation of the deformation of a simple circular arch, subject to radial loads. The methods adopted are of a somewhat cumbrous and indirect character. This complication seems to have caused the authors to fall into some errors, which I shall indicate further on, and has thus detracted from the value of a most painstaking paper.

The first of these is of so simple a character that it is difficult to see how it can have arisen. Thus, suppose two

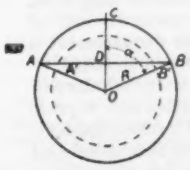


Fig. 1.

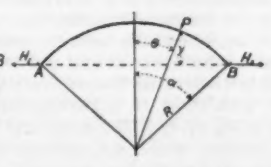


Fig. 2.

points, A and B, Fig. 1, on a thin circular ring, which is exposed to external pressure.

Under this pressure the points A and B will move inward along a radius to new positions A^1 B^1. It is perfectly obvious that this change is exactly of the same kind as would be brought about by a diminution of temperature, and hence the specific contraction of a line connecting any two points will be constant. Now the stress in the arc A B is obviously $\frac{q\,R}{F}$ if q be the exterior pressure, R the radius and F the cross-section of the ring. Hence the specific contraction along the arc A B will be $\frac{q\,R}{F\,E}$ and this will also be the contraction of the chord A B. Hence the shortening of this chord will be $\frac{q\,R}{E\,F} \times A\,B$, which reduces to $\frac{q\,R^2}{E\,F}\sin\alpha$ for the half chord $D\,B$.

By some peculiar course of reasoning, extending over four pages, the authors of the paper make this $\frac{q\,R^2}{E\,F}\alpha\cos\alpha$. In the present instance it is only fair to state that the difference is not large.

It is, however, in connection with the effect of this shortening of the arch that the authors have taken the most important step in advance. It is obvious that the abutments of a dam being rigid, the chord A B cannot follow the compression of the arch by shortening in the way assumed, but the points A and B are maintained in their original positions by the abutment reactions. Hitherto these additional reactions at the abutments have been totally neglected, but in the present paper a long mathematical investigation is gone into to ascertain their values, but I am sorry to say that I am unable to get the same formulæ as those given in the paper. It was difficult to locate the errors at their source, but as far as I can see they appear to have risen in the following way: The authors assume that the angle between the tangents at A and B will be altered through the arch compression acting alone. This is, of course, inaccurate, for as pointed out above the deformation in this case is exactly that which would arise from a reduction of temperatures and the points A and B move in radially.

As regards the errors themselves, the authors denote by M the moment which arises at the abutments owing to their rigidity, and by H_1 the modifying reaction which maintains the span of a constant length, and then give the following equation between them:

$$M = \frac{H_1 R}{\alpha}(\sin\alpha - \alpha\cos\alpha) + q\,\frac{T}{F}$$

Here α denotes the semiangle subtended by the arch. R the mean radius, q the load on arch per foot run, T the moment of inertia of the arch section, and F the area of same. By a direct process I find that the last term should not appear, and $M = \frac{H_1 R}{\alpha}\sin\alpha - \alpha\cos\alpha)$ simply . . (1)

Finally, the expression given for the reaction H_1 is also inaccurate; it should read, $H_1 =$

$$\frac{q\,R\sin\alpha}{\frac{R^2\,F}{T}\left\{\alpha\left(1+\tfrac{1}{2}\cos 2\alpha\right) - \tfrac{3}{4}\sin 2\alpha - \frac{(\sin\alpha - \alpha\cos\alpha)^2}{\alpha}\right\} + 2\alpha - \frac{\sin 2\alpha}{2}} \qquad (2)$$

or, neglecting the effects of shear as is done in the paper, $H_1 =$

$$\frac{q\,R\sin\alpha}{\frac{R^2\,F}{T}\left\{\alpha\left(1+\tfrac{1}{2}\cos 2\alpha\right) - \tfrac{3}{4}\sin 2\alpha - \frac{(\sin\alpha - \alpha\cos\alpha)^2}{\alpha}\right\} + \frac{2\alpha + \sin 2\alpha}{4}} \qquad (3)$$

In the paper $H_1 =$

$$\frac{q\,R}{\frac{R^2\,F}{T}\left\{\frac{(\alpha+\sin\alpha\sqrt{2})(\alpha-\sin\alpha\sqrt{2})}{2\alpha\sin\alpha} + \frac{\cos\alpha}{2}\right\} + \cos\alpha}$$

As the authors' methods of dealing with the deformation of a compressible arch are very indirect, and as these results are also inaccurate, it may be of interest if I indicate the short method by which the correct results given above were arrived at. I have already shown that under the action of a set of radial loads of q lbs. per ft. run the span $A\,B$ of a compressible arch would tend to shorten by an amount $\lambda = \frac{2qR^2}{E\,F}\sin\alpha$, where the signification of the letters has already been given. Further if the arch acted in this way the horizontal thrust would obviously be $q\,r\cos\alpha$. Since, however, the span is actually unaltered, there will be an additional reaction arising at the abutments of such a kind that under it the span of the arch will be increased by λ, and hence the total change in length would be zero. Further, as the angle between the tangents at the extremities of the arch is unaltered, there will arise a moment at the abutments which we may denote by M. Let H_1 be this additional horizontal reaction. Then to determine its value the best plan is to proceed by the method of work. At any point P, Fig. 2, the moment acting on the arch will be $M - H\,y = M - H_1 R \times (\cos\theta - \cos\alpha)$. The work done on an element ds of the arc by this will be $\frac{\frac{1}{2}(M - H\,R(\cos\theta - \cos\alpha))^2}{E\,T}\,ds$, where T = moment of inertia of section. Resolving H_1 along the arch at this point, we get the normal thrust $= H_1\cos\theta$, hence work done by this one element is $\frac{H_1{}^2\cos^2\theta}{2\,E\,F}\,ds$. Finally the normal shear is $H_1\sin\theta$, and work due to it is $\frac{A\,H_1{}^2\sin^2\theta}{2\,G\,F}\,ds$, where G = transverse modulus of elasticity and A = a geometric coefficient, say $\frac{6}{5}$, whilst G may be taken as $\frac{2}{5}E$. Hence total work done on whole arch

$$= U = \tfrac{1}{2}\int_{-\alpha}^{+\alpha}\left\{\frac{[M - HR\ (\cos\theta - \cos\alpha)]^2}{ET} + \frac{3H_1{}^2}{EF}\sin^2\theta + \frac{H_1{}^2\cos^2\theta}{EF}\right\}R\,d\theta$$

Now $\frac{\delta U}{\delta M}$ = change in angle between tangents at abutments = O in this case; this gives rise to equation (1) on completing the integration.

Again, $\frac{\delta U}{\delta H_1}$ = change in length of span = λ,

an equation which combined with (1) gives rise to equation (2), as given above.

Using these correct values of the quantities H_1 and M we find that of a horizontal layer of the dam 1 ft. thick, at a depth of 21.5 ft. below the water level, resisted solely as a compressible arch, no serious tension would be developed, and the maximum pressure would not reach the crushing strength of the masonry. As for the other layers, it would appear that all above this point would be quite capable of resisting the loads on them by acting in this way as arches, were they free to take the deflections required. As for the layers below this point, such excessive stresses would be developed that failure would appear certain, and this view is that held by the authors of the paper.

It seems, however, that the lower half of the dam would, acting as a straight dam, be capable of resisting the actual load on it, even if it received no assistance from its curvature without the development of tensions exceeding about 250 lbs. per sq. in. Hence it appears that if the upper half of the dam acted mainly as an arch, and the lower half mainly as a straight dam, the stability of the structure could be explained. The question is, Could this be the case without such excessive deflections that serious cracks it the masonry would arise? The authors of the paper think not, but I differ from them for the following reasons:

In the first place, owing to the moments introduced at the abutments, the arch will be stiffened, and the deflection at the crown will, I believe, be less than that assumed by the authors, though I have not made the calculation. Secondly, throughout their investigation the authors have assumed that the material of the dam is perfectly elastic, or, in other words, that masonry obeys Hooke's law throughout the whole range of the stresses to which it is in practice subjected. This assumption is indeed almost necessary for the investigation of the subject, but it is nevertheless inaccurate for most stones. In UNWIN'S "Testing Materials of Construction" it is stated that stone takes a permanent set under small loads, and only obeys Hooke's law after this point is passed.

From this it follows that the deflection of a stone structure would be greater than that calculated from the modulus of elasticity, and it would thus appear possible that in this way the whole dam might have taken a sort of plastic yielding on being first loaded, by means of which it was brought into a better condition to resist the load on it, than would appear from a mathematical investigation of the structure considered as acting as a perfectly elastic solid *ab initio*. Certainly experience shows that masonry will stand a considerable deflection before cracking, provided only the deflection takes place sufficiently slowly, as most of us have seen old walls bulged out considerably by pressure behind them. If it be granted that this could occur to even a limited extent in the case of the Bear Valley dam, its stability could be easily accounted for and without any such extravagant assumption as that which Messrs. VISCHER and WAGONER conclude their paper. They assume, indeed, that the abutments are entirely removed and that the dam resists solely as a beam having a segmental cross section. This assumption is certainly less accurate than the one I proposed above. It might even happen that the dam would finally take a permanent set so that the moments at the abutments would be eliminated, in which case the differential equation in ENGINEERING NEWS for Aug. 16 would give a solution of the problem at once and with a minimum of labor. In any case that equation will be applicable to dams having a large amount of curvature, as then the moments at the abutments will be small.

In conclusion I must say that though I have found it necessary to differ from the authors of the paper on several points I have learned a great deal from its perusal, its matter being most suggestive.

H. MEDWAY MARTIN.

The Steel Armor Tests at Annapolis.

We gave a brief account last week of the results of the first day's firing in the government tests of steel armor plates at Annapolis. The trials were completed on Monday, Sept. 22. These are the first armor plate tests ever made in this country, and are the first ever made under such severe conditions anywhere.

Some months ago Secretary TRACY decided to make a test of the Holtzer chrome steel armor

piercing projectile, and for that purpose he ordered of Schneider & Co., of Le Creusot, France, two armor plates, one to be made of solid steel with about 0.33% of carbon, and the other to be of the composition known as nickel steel, being mild steel with 5 per cent. of nickel. Before the test was arranged, however, representatives of Cammell & Co., of Sheffield, England, petitioned that a plate of that firm's manufacture, made of a compound of steel and iron, under the Wilson patent, be tested in competition with the plates of Schneider & Co.

The request was granted and preparations have been for some time going forward for the test. The plates were set side by side in front of a large earth mound and were backed with 36 ins. of solid oak. The gun used on the first series of tests was a 6-in. rifle, 17¼ ft. in length, made at the Washington Navy Yard especially for the purpose in 52 days. It was set with its muzzle 30 ft. from the plates and was mounted on a carriage, so that it could be turned to point squarely against any part of either plate.

The projectiles used were Holtzer chrome steel ogival headed shells, 17 ins. long, 6 ins. in diameter and weighing 100 lbs. The firing charge was 44¼ lbs. of cocoa powder. The initial velocity was about 2,075 ft. per sec., giving a muzzle energy of 3,342,876 ft. tons.

Bomb proofs were provided at a respectful distance from the plates, to which the spectators could retire when the shots were fired. Four shots were fired at each plate, beginning with the lower right-hand section, then in the lower left-hand section, then in the upper left-hand section, and then in the upper right-hand section. The first shot was fired at the all-steel plate, the second, at the compound plate; the third, at the nickel-steel plate; the fourth, at the all-steel plate again, and so on. Each plate was 4 ft. high and 6 ft. wide. The Schneider plates were 10.5 ins. thick and the Cammell plate, by an error in rolling, was $\frac{1}{10}$ in. thicker. The results of the shots were as follows:

Schneider All-Steel Plate.—First shot penetrated about 6 ins., remaining fast in the plate, which was burred up somewhat around the shot, but not cracked. Second shot struck plate squarely, penetrated nearly through it and rebounded to a point about 25 ft. from the plate. The plate was not cracked. The shell itself was shortened 0.11 of an inch, but did not seem to be injured in the least. Third shot penetrated just through the steel, a total of 12 ins. from the front face of the plate, and rebounded like the second. Fourth shot penetrated 12½ ins. The projectile broke, the point remaining in the plate and the base rebounding.

Schneider Nickel-Steel Plate.—First shot penetrated just to the back of the plate. The projectile broke and the rear rebounded. Second shot penetrated 14½ ins. The plate was uncracked. The projectile was unbroken and remained in the plate. Third shot penetrated 13½ ins. and remained in the plate. The plate was not cracked and the projectile was little injured. Fourth shot penetrated about 13 ins. The plate was not cracked. The projectile broke and the base rebounded.

Cammell Steel and Iron Compound Plate.—First shot passed entirely through the plate and lodged in the oak backing with the point 28 ins. from the face of the plate. The face of the plate was splintered off about 3 ins. deep all around the hole. Three large cracks and several smaller ones were made in the plate, extending in two cases to the outer edge, and two bolts of the backing were started. Second shot passed clear through the plate and lodged in the oak backing; the total penetration being 32 ins. The cracks made by the first shot were opened to wide fissures, and the lower half of the plate was pretty thoroughly wrecked. The front of the plate scaled off to a depth one to two inches, and around the shot hole a considerable hollow was made. The projectile was broken. Third shot penetrated to a point 40¾ ins. from the face of the plate and lodged in the backing, setting it on fire. Cracks were formed all around the hole, extending to the edge and through the whole thickness of the plate. Fourth shot penetrated through both plate and backing and broke up, one piece falling just behind the target and the other lodging in the hillside 100 ft. beyond, into which it penetrated 4 ft. The upper quarter of the plate in which the shot struck was stripped of its steel face, at least 300 lbs. of metal being torn off, to the depth of 6 ins. in places.

On Sept. 22 the tests were concluded by a shot at each plate with an 8-in. rifle firing an armor-piercing projectile made by the Carpenter Steel Co., of Reading, Pa., by the Firth process. The projectile weighed 210 lbs. and was fired by a charge of 85 lbs. of powder, giving an initial velocity of 1,850 ft. per second. The shot was aimed in each case at the center of the plate.

The first shot was fired at the Schneider all-steel plate and the projectile penetrated through the 10½ ins. of steel and 4½ ins. into the oak backing and rebounded, broken transversely into three almost equal pieces. The plate was cracked into four pieces by four cracks radiating from the hole made by the last shot, each crack extending through one of the 6-in. shot holes to the edge of the plate. There were no other cracks. The metal was somewhat scaled off around the hole.

The second shot was fired at the nickel-steel plate, and the projectile pierced clear through it and into the oak backing, a total of 21½ ins., being 6½ ins. more than the penetration in the all-steel plate and its backing. Again the projectile was broken up, the point remaining in the hole and the base being scattered in all directions. The hole in the plate was quite ragged, owing to the breaking of the projectile, but no crack appeared in any direction.

The final shot was aimed at the already badly wrecked Cammell plate, and the projectile passed entirely through the plate and backing, cut one of the 12-in. backing props half in two and penetrated the earth back of the target for a distance of 15 ft. The entire steel face of the plate was torn off, except a few edges on the sides, and the wrought iron remaining was cracked in every direction.

It thus appears that the solid steel armor is far superior to the compound armor having a hard steel face and a wrought iron back, when tested with modern high-power guns using armor-piercing projectiles. As regards the relative efficiency of the steel plate and the nickel-steel plate, the latter must be conceded to have proved on the whole the better defense, as it was not cracked by the 8-in. shot in the center, as was the all-steel plate. On the other hand the penetration of the all-steel plate was in almost every case less than that of the nickel steel, thus showing the latter to be somewhat softer and tougher than the former. The newspapers have jumped at the conclusion that the nickel-steel plate is the superior for practical use, which seems at least premature. The extra cost of the 5 per cent. of nickel added to the steel (nickel being now 80 cts. to 85 cts. per lb.) adds a large proportion to the cost of armor plate, but in a case of this kind differences of cost, within any reasonable limits, are of minor moment.

Irrigation in Australia.

Irrigation in Australia presents some problems similar to those in this country, especially as regards the distribution of intercolonial waters. Both Victoria and New South Wales have claims upon the Murray and Darling Rivers, and to ensure an equitable distribution the supply of these streams is under the control of commissioners who supervise both the distribution and conservation of the water. The principal problem in this country is interstate distribution, over which supervision will eventually be necessary, and in addition there is the distribution between the United States and Mexico of the waters of the Rio Grande.

Our agricultural department is now preparing, under the direction of Col. R. J. HINTON, a report on artesian wells and their relation to agriculture in the West. In 1869 New South Wales began the investigation of artesian wells and underground supplies, appropriating $25,000 for borings. Within a short time the colonial government has appropriated as much as $1,000,000 a year for well-boring. In 1889 the government of Queensland had five artesian wells, from 180 to 1,663 ft. deep, and others were being bored. There were then 11 private wells, and 14 additional private wells under construction. The general policy in Australia seems to be for the colonial governments to retain control over the water supplies, reserving them for the use of the public, and even developing and conserving the supplies, and furnishing water at reasonable prices.

Some additional information on irrigation in Australia is given in the St. Louis *Globe-Democrat* of Sept. 20, to which we are indebted for this data, but most of the data is from two to six years old, as: "two or three" years ago the cost of constructing irrigating works in Victoria had been $6,792,000, and the cost of maintaining them $389,000, while the revenue for one year was $1,215,000. And again: "In 1884, including government and private waterworks, in the whole of New South Wales, there were 17,071 tanks and wells." These had cost $19,802,000, or an average of $1,160 each. There were also 8,579 dams, which had cost $4,176,000, or an average of about $475 each.

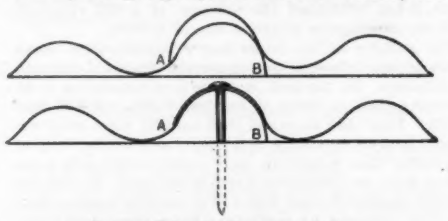
"Patent Edge" Corrugated Iron.

The Cincinnati Corrugating Co., of Piqua, O., has recently introduced the modified form of corrugated iron shown in the accompanying sketches, all regular 2½-in. corrupated iron roofing and siding being furnished without extra charge with the special edge corrugation shown, ¼ in. deeper than the rest and of different form.

The edge corrugations are made so that the outer edges are nearly vertical, as at *A* and *B*, instead of flaring, as is usual. The advantages claimed for this improvemement are:

1. The nails used in fastening are driven vertically through the tops of the highest corrugations, so that it is impossible for rain to leak through, as the heads thus cover the holes best, and water drains away from the nails promptly, making lead washers useless expense.

2. The flange of the outside lapped corrugations of this style hugs tightly, while in the ordinary cor



"Patent Edge" Corrugated Iron.

rugated iron it is only held tightly at the nails, flares open between, admitting rain freely.

3. Owing to the form of the outside corrugation, the sheets will cover 4% more than roll corrugated sheets of same width; but, moreover, as the ordinary form of corrugated sheets requires a lap of two corrugations to be effective, a saving is, in such case, effected of fully 14%.

4. The edge flanges, being vertical, impinge on the roofing supports, as at *B*, and thus rigidly and strongly uphold the lapped joint, keeping it watertight, without using wooden strips. Ordinary corrugated sheets readily yield to pressure and open up at joints.

Reversed ends of roll corrugated sheets cannot match. This material is always corrugated and inspected before painting, and the painting is done by brushing, not by dipping.

A Steam Lifeboat.

A steam lifeboat driven by jets of water was recently tested at Blackwell, England, and showed a remarkable efficiency in view of the unsuccessful attempts at jet propulsion heretofore made. According to *Industries*, to which we are indebted for the accompanying cuts, this boat is 50 ft. long, 14 ft. 3¾ ins. in extreme breadth, and has a draught of 3 ft. 3 ins. when fully loaded. The displacement is 21 tons, with 3 tons of coal and 39 men on board.

The boiler is of the Thorneycroft patent tubular pattern, with 600 sq. ft. of heating surface and a grate area of 8½ sq. ft. The compound surface condensing engines, which are reported to have developed nearly 200 HP. during the trials, are placed at a slight angle with the horizontal. The cylinders are of 8½ and 14½ ins. diameter respectively, and of 12-in. stroke. They are connected directly to the shaft of a turbine, situated amidships and taking water through an opening in the bottom, as shown in the elevation. The inclination of the inlet is said to effect a saving in power over an ordinary flush inlet of some 30 per cent. Four discharge pipes conduct the water from the turbine, two below the water line and opening toward the stern, and two above the water line and opening toward the bow, as shown by the dotted lines in the sectional plan.

When the engines are once started they are not stopped until the boat is to stop also. Valves controlled by 2 levers on deck near the wheel enable the helmsman to send the immense mass of water, 60 tons per minute, astern or ahead, and thus propel the boat in any direction without communicating with the engine room. In order to turn quickly one valve can be set for a forward and the other for a backward motion, and the rudder thus materially aided in directing the boat.

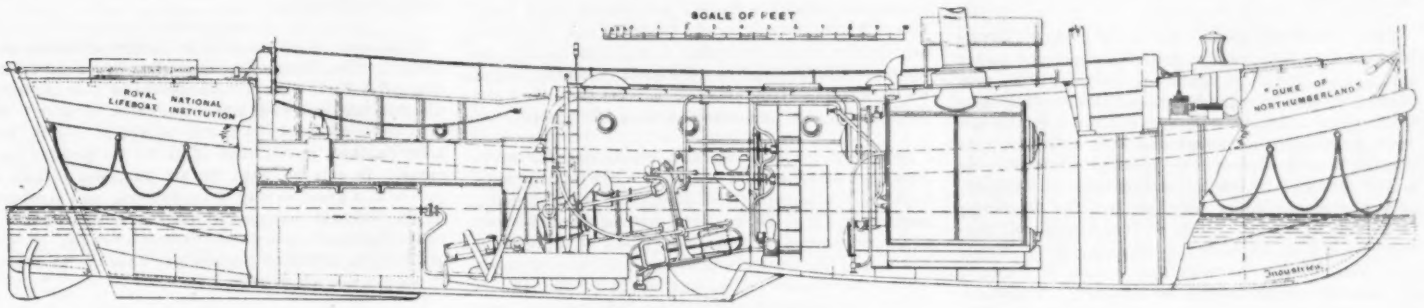
The mean speed on a measured mile is 8⅓ knots an hour, and the boat carries enough coal to last 30 hours at an average consumption of a little over 225 lbs. per hour under forced draught.

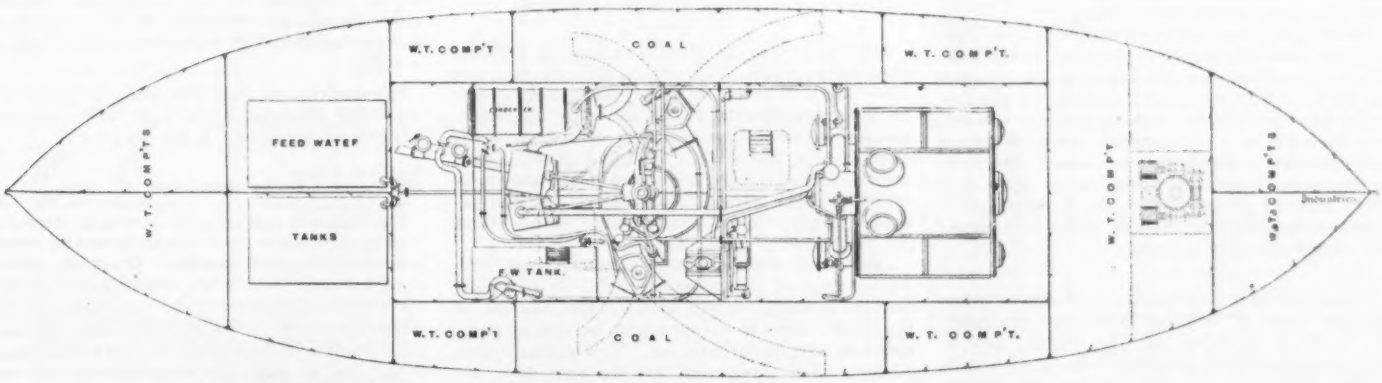
Going at full speed she made, with the rudder, a half-circle in 25 seconds, and the full one in 50 seconds. Going slowly, with rudder and turbine, the full circle was made in 40 seconds, and with turbine alone in 52 seconds. By working the levers on deck, the boat was brought from full speed to a dead stop in 32 seconds, and from dead stop to full speed in 4 seconds. These tests, which were conducted with the greatest accuracy, showed how entirely the vessel was under the control of the officer on deck, no communication being necessary with the engine-room whatever, as the machinery always runs in the one direction.

If the boat will do as well in a storm, it will prove a valuable addition to the facilities of the Lifeboat Institute. Paddlewheels are out of question as a means of propulsion, and the screw offers but few advantages on account of its liability to race in a heavy sea. With jets of water, however, it makes but little difference, it is stated, whether the discharge takes place above or below the water line, and hence this system is much to be preferred.

The hull and bulkheads are all made of the best steel procurable, and the riveting is much stronger than is usual in small vessels. The stability of the boat is remarkable. In tests at Blackwell, she was thrown on her beam ends, but immediately righted. The strength and seaworthiness are further increased by a complete system of water-tight bulkheads, giving in all 15 water-tight compartments, each of which can be rapidly drained by bilge pumps and steam ejectors.

The boat was designed by the Chief Inspector of Lifeboats, Capt. H. W. CHETWYND and Mr. JOSEPH GREEN, of the firm of R. & H. Green, of Blackwell, her builders.





THE STEAM LIFEBOAT "DUKE OF NORTHUMBERLAND."—H. W. Chetwynd and J. Green, Designers.

The Determination of Air Resistance.

BY ASST. PROF. H. A. HAZEN, U. S. SIGNAL SERVICE.

The problem is to obtain the total resistance of the air, first upon plates of various dimensions, and, second, upon objects more or less prismatical. The resistance upon plates is known to be made up of two parts: first, a pressure due to the impinging of the air current upon the front of the plate, and, second, an additional pressure amounting to nearly half the first and due to a partial vacuum in the rear of the plate. Owing to vortex motions set up on the sides of the plates and other irregularities, the experimental determination of this resistance in air becomes exceedingly difficult and no two results have agreed, though the problem has been attacked by prominent physicists and engineers. We may lay down a few general principles which should guide us in a research of this kind.

1. Owing to a peculiar effect which is brought about by a heaping up of the air in front of the plate, and which becomes quite complicated in a varying velocity, it is quite essential that the velocity of the current upon the plate or of the plate though the air be uniform.

2. It is also necessary that no surface, from which air could be deflected or upon which it could be heaped up, be allowed within 4 or more feet of the sides, or within 30 or more feet of the rear, or at all in front.

3. It is essential that the current impinge normally to the surface exposed. All experiments with a whirling arm, except at very low velocities, are faulty. The cause of the difficulty in this case is principally a flow of air across the plate from the center of evolution, like the flow from the blades of a revolving fan.

4. It is essential that the measurement of the pressure upon the plate be made with as little interference with the plate as possible.

Undoubtedly many other points would be met that would need solution on the spot, but it is believed that the above general principles cover most of the ground. It will be seen that these principles limit very materially the methods to be used in solving this problem. The principal method that has been used thus far has been a whirling arm, because of its ease in manipulation and the perfect control one can have over its velocity. I think it can be shown, however, that most of the discrepancies thus far found in solutions of the problem have been due to this method, and that nothing more can be satisfactorily determined with an arm of 28 ft. at least. Experiments with falling plates have been tried, and while this would be an interesting investigation to repeat, yet it hardly seems as though much would result from it. Experiments with the actual wind have been tried often and have given fairly satisfactory results, but the intermittent character of the wind precludes any but approximate values.

There still remains a method which seems very simple, in fact, the most simple of all, and one that is entirely feasible namely, to use two or three platform cars loaded with railroad iron to keep them from jumping the track, and pushing them in front of a locomotive. The plates should be exposed either on or at the side of the forward end of the front car, thus leaving a clear space on all sides and especially to the rear. There would be needed about two miles of straightaway track and possibly a little extra track upon which to get up speed. Experiments should be tried with plates from 1 to 10 ft. square, and with solids as large as can be used; also, with both continuous and reticulated surfaces.

In choosing the best method of measuring the pressure upon the plate, two suggestions may be made; though of course modifications would be needed and could easily be made on the ground after all the circumstances were in hand. 1. The plate may be allowed to swing by two cords fastened to a rigid frame at a height of 10 ft. or more above the car. The angle the plate makes with the vertical (which is never to exceed 15°), together with the weight of the plate, gives the total pressure at once. This is by all means the most delicate method of getting the pressure. It is the least objectionable of all methods, and certainly for very low velocities it is far superior to any and all other contrivances. The results by this method should be checked by the use of springs carefully calibrated. In the latter case the plate may be suspended as before, but its backward swing may be stopped by two uprights on the car, one at each end of the plate, and placed about 2 ins. from the vertical. Four wires should run to a point in front of the plate, say 2 ft. from it, fastened to the four corners and at their intersection joined to the spring or dynamometer. The elongation of this spring may be effected by passing a cord from it over a pulley far in front of the plate. When this

cord is drawn up, the exact elongation of the spring may be read off from a convenient scale. The cord should be drawn up until the plate is pulled into an exact vertical; several repetitions of this ought to give a very fair result for each velocity. Many other methods might be suggested, but these seem the easiest and best to be used.

Experiments may be tried upon a still day, but if a light breeze is blowing its velocity relative to that of the plate may be determined and allowed for. The car should be run in both directions, that is, forward and back over the same track.

THE REMOVAL OF THE IRON GATES OF THE DANUBE RIVER was begun Sept. 15 in the presence of the Prime Ministers of Hungary, and Servia, the Austrian Minister of Commerce, and other officials.

THE EXPENSE OF REPAIRING THE LEVEES OF ARKANSAS, which were injured during the past year is estimated at nearly $1,000,000 by Capt. E. C. TALLINGER, U. S. A. In order to raise the levee line 2.7 ft. above the high water mark of last spring and give an 8-ft. crown, some 4,754 cu. yds. of filling will be required.

THE INCORPORATORS OF THE NORTH RIVER BRIDGE CO. (Lindenthal project), chartered under the Act of Congress approved July 11, 1890, met Sept. 19 in this city for organization and other preliminaries. All the incorporators named in the act were present either in person or by attorney; the charter was accepted; the stock of $1,000,000 (the minimum fixed by the act) was at once subscribed, and the stockholders then elected the following Board of Directors: THOS. F. RYAN, JOHN K. MCLANAHAN, JAS. ANDREWS, JORDAN L. MOTT, EDW. F. C. YOUNG, WM. BROOKFIELD, CHAS. J. CANDA, all men of standing and prominence. There are only 7 directors of this company under the act. The directors subsequently met and elected JORDAN L. MOTT, President; CHAS. J. CANDA, Treasurer; M. H. HOUSEMAN, Secretary; CHAS. F. MACLEAN, General Counsel, and GUSTAV LINDENTHAL, Chief Engineer. A committee was appointed to prepare by-laws and other necessary proceedings.

The company's headquarters will be in New York City; another office will be on the New Jersey side. A corps of engineers are preparing for the engineering work. We rejoice to learn that, if we are correctly informed, all the needed capital is assured; more than will be required having been offered on favorable terms. The project is a sound one, is in no respect an attempt to infringe on the rights of a prior company or appropriate the conceptions of other persons, and would appear to be, both financially and technically, a strong one.

THE BROOKLYN BRIDGE BOARD OF EXPERTS has received some 46 different plans for enlarging the terminal facilities of the bridge, and is said in the daily press, we have no doubt with substantial truth, to have at once thrown out all but six or eight of them as impracticable and absurd. It is likely to be two or three months yet before any final report is submitted, in spite of frequent reports in the daily press that such report will be speedily rendered. The present Board consists of Messrs. SAMUEL SPENCER, C. W. BUCHHOLZ and GEO. W. PLYMPTON. The former Board, which reported Feb. 23, 1888, consisted of Messrs. WALTER KATTE, JULIUS W. ADAMS and JOSEPH CRAWFORD. The plan recommended by the former Board of Experts, that by Mr. A. M. WELLINGTON, is not as yet formally before the second Board of Experts, owing to an attempt of the Bridge Trustees to impose a new and unprecedented condition for the receipt of plans.

THE NEW CONDITION for receiving plans for the bridge terminals, as published in the advertising columns of ENGINEERING NEWS, Aug. 2, is that: "No compensation will be made to any person for plans or drawings unless adopted [not even if recommended by the experts], and in such case the compensation will be fixed and determined by the Board of Trustees, whose decision shall be final, and not subject to question or appeal." This condition Mr. WELLINGTON has refused to accept, under any circumstances, and the question now lies between withdrawal of this condition and a report by the second Board of Experts, without having before them the plan which the first Board of Experts recommended with rather unusual emphasis, declaring it to be "unquestionably the one which best and most completely fits the conditions presented;" and "the one alone which seems best to conform to the necessary conditions, in which the objectionable features of all the others are eliminated." As the second Board of Experts is, in effect, sitting as a Court of Appeals from the decision of the first Board, it will be seen that such an omission would be at least unusual.

DIVERSION OF WATER FROM THE ERIE CANAL has stirred up quite a controversy at Lockport, N. Y., between the boatmen and the manufacturers. The State Engineer has been requested to investigate the matter and determine whether the taking of water from the canal for water power has caused any detriment to navigation. There seems to be little doubt that the water has been drawn off with most improper freedom.

THE CHESAPEAKE & OHIO CANAL LITIGATION still continues. The latest is a proposition of the holders of the bonds of 1844 to take possession of the canal and assume all liabilities having precedence over their own. Notwithstanding the report of the receivers, which was to the effect that it was not feasible to operate the canal and pay the interest on the cost of its repair, these bondholders believe that they can do this and pay the bonds issued in 1878 besides.

SURVEYS FOR THE CHICAGO DRAINAGE IMPROVEMENT are making good progress. The field surveys between Chicago and Summit will be completed during October. They will be pushed toward Joliet as far as possible before the close of the season. Borings in the Desplaines Valley will be continued during the winter. A reconnoisance of the Illinois Valley is in progress and will be finished this season. An investigation of the flood conditions in the water sheds of the Desplaines and Chicago rivers has been undertaken and investigations concerning the flow of water in the proposed channel are under way. The total expense of the surveys from Aug. 1 to May 1, 1891, is estimated to exceed $125,000.

A NOVEL SYSTEM OF STREET NAMING is proposed for Seattle, Wash. The city is divided into two quite distinct parts by Yesler Ave. The streets running perpendicular to this are to be numbered, and instead of designating them according to the usual custom, the streets north of Yesler Ave. are to be called streets, and those south are to be called avenues. Thus "North First St." will become simply "First St.," and "South First St." will be called "First Ave."

The streets running parallel with Yesler Ave. are to be named, but the names are to be so chosen that the initial letter will indicate the location of the street. Thus the order might be, Adams Ave., Belmont Ave., Cedar Ave., etc. This same system, a very good one, was used (for the first time, we believe) on the Back Bay of Boston, where the successive streets are Arlington, Berkeley, Clarendon, Dartmouth, Exeter, etc.

THE ELECTRIC LIGHTING PLANT of Ypsilanti, Mich., which is owned and operated by the city, has come into a good deal of prominence of late in the discussions over the relative desirability of a city or a corporation owning the public electric lighting plant. Mr. VICTOR ROSEWATER of Johns Hopkins University in a contribution to the New York *Independent* stated that the total cost of the street arc lamps at Ypsilanti was but $23 per year. Mr. W. R. COATS, who was the engineer in charge of the construction of the Ypsilanti water-works, with which the electric lighting plant is connected, writes us that figuring the interest on the cost of the plant at 5% and the depreciation at 10% (which, however, he considers very low), the cost of the Ypsilanti lights is $86 per lamp per year.

RECENT APPLICATIONS OF THE ELECTRIC WELDING PROCESS are to the manufacture of projectiles and of wheels. In making armor piercing shells, the difficulty hitherto has been to make the point hard enough to sustain the impact without flattening and at the same time make the walls of the chamber of material tough enough not to break when the projectiles strikes. But a steel hard enough to meet the first requirement has been very difficult to work. By the new process of manufacture the point of the projectile, which is made of the hardest steel, is welded in an electric welding machine to a tube of mild steel which forms the chamber of the shell. The butt of the shell is made of a piece of cup shaped hydraulic forged steel somewhat harder than that surrounding the chamber. The slight protrusion on the interior of the shell where the welds come is a benefit rather than otherwise, since it tends to strengthen the projectile.

In the wheel making process which is now being perfected, all the spokes are welded to the hub at one operation.

THE ELECTRO-DEPOSITION OF WROUGHT-IRON is a scheme on which STEPHEN H. EMMONS, a Pittsburg inventor, is engaged. The pig-iron is placed in vats filled with a chemical solution and forms the negative pole. Thin sheet-iron plates suspended in the bath form the positive pole. The current of electricity is furnished by a dynamo, and it is stated that iron of chemical purity and remarkable toughness is deposited on the positive plates. Whether the invention can be made a commercial success does not yet appear.

FUEL GAS is to be sold in Boston at 60 cts. per 1,000 ft. The Boston Gas Light Co. has announced that after Nov. 1, on certain streets in the business district, fuel gas with a calorific value of about 400 heat units per cubic foot, will be sold at 70 cts. per 1,000 ft., less a discount of 10 cts. for prompt payment. It can be used for all purposes of heat or power at a great saving to customers, and is especially useful and economical for cooking. If it appears that there is a public demand for gas of this quality, the company proposes to extend its mains to supply the whole city.

CHEAP FUEL GAS has just been introduced in Chicago, also at Hyde Park, where the Mutual Fuel Gas Co. has established works with a capacity of over 2,000,000 ft. per day. The company's rates are 50 cts. per 1,000 ft. against 60 cts. in Boston, with a probable discount to large consumers. About 42 miles of mains are controlled by the company, and it is claimed that 3,000 consumers have already been secured.

IMMIGRATION is still increasing, in spite of the very large aggregate of last year, which was among the highest on record. It has been for—

	1890.	1889.	Incr.
Month of August	37,387	31,418	5,969
Eight months ending with August	335,921	300,563	34,358

The tendency to increase is strongest from Italy, Russia and Poland; British, German and Swedish emigration is not increasing. This more desirable class, however, even now, constitutes about 70% of the whole, and the total of the undesirable elements which have come to this country is still an insignificant fraction of the whole. So far as immigration is any sign, we seem sure of another year, at least, of "good times."

EXPORTS AND IMPORTS also show a strong continuing tendency to increase. For the 12 months ending with August they have been for the past six years, in millions of dollars:

	1884-5.	1885-6.	1886-7.	1887-8.	1888-9.	1889-90.
Exports	723.3	693.6	717.0	683.1	702.5	856.3
Imports	571.6	649.9	730.3	719.4	764.2	791.2
Excess expts.	151.7	43.7	16.7	(—36.3)	(—1.7)	65.1

CONSTRUCTION NEWS.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

American Midland.—Press dispatches from Chicago say:

Another great trunk line is to be built from New York to Chicago. It is to be known as the American Midland R. R., and is to begin at the terminus of the Central R. R. of New Jersey in Jersey City. It will run across New Jersey and traverse the anthracite coal region of Pennsylvania, and will then pass through the bituminous and oil sections of Ohio. The road is to be built chiefly with English capital, but a number of influential Americans, including Russel Sage and Sidney Dillon, are said to be interested. It is said that the surveys, location, rights of way, grading and all preliminaries of that nature have been attended to, and the work of construction will be commenced immediately. About 150 miles of the intended route is already built and in operation from Findlay, Ohio, to the Pennsylvania-Ohio State line.

Escanaba, Iron Mt. & Western.—It is stated that this road will be extended to Ishpeming, Mich. The road is now under construction from Escanaba to Iron Mt., 100

miles. G. M. Willis, of Iron Mt., Mich., is Chief Engineer

Baltimore & Ohio.—It is expected that the Akron & Chicago Junction R. R., which is being built from Akron to Chicago Junction, Ohio, 73 miles, will be completed by Jan. 1.

Lake Shore & Michigan Southern.—The location of the first 12 miles of the Toledo & Ohio Northern R. R. has been completed.

Cleveland, Cincinnati, Chicago & St. Louis.—The preliminary survey for the proposed line from Brookville to Union, Ind., has been completed. The length of the line will be 58 miles; maximum grade 40 ft. per mile and maximum curve 4°. The heaviest work will be near Richmond, Ind. It is stated that the road will be built soon.

Ticonderoga.—A correspondent writes:

This road is being built to connect mills at Ticonderoga, N. Y., with the Lake George & Lake Champlain branch of the Delaware & Hudson Canal Co.'s Ry., by which it will be operated. The total length is 2.31 miles, and comprises the main line, 7,400 ft. long, a switch-back to the Ticonderoga Pulp & Paper Mills, 3,000 ft. long, and a branch to Island Mills, 1,800 ft. long. Construction began July 30, and it is expected to have the road completed this fall. C. H. DeLano, of Ticonderoga, is president, and Chappell & Burke, of Rutland, Vt., are the engineers.

Brigantine Beach.—A correspondent writes us that the 8,000 ft. extension of this road to Brigantine Beach has been completed and opened for traffic. The greater part of the road, which was projected to run from Pomona to Brigantine Beach, was completed last year. The route is through an almost level sandy country; maximum grade 0.1%, and maximum curve 4°. The principal business will be in the summer resort passenger traffic and oysters. Hill & Stout, of 42 Broadway, New York City, were the engineers, and J. W. Coffin & Co., of 50 Broadway, New York City, were the contractors.

Franklin & Tilton.—A correspondent writes as follows:

This road runs from Franklin Station on the Northern R. R. to Tilton Station on the Concord & Montreal R. R., a distance of 4.93 miles. The maximum grade is 1.55%, and the maximum curve is 8°. There is a two-span truss bridge 297 ft. long, with a 115 ft. trestle approach across the Merrimac River. About 100 men are at work on the line and it is expected to commence tracklaying about Oct. 1. The contractors for the earthwork and culverts are Moulton, O'Mahoney & Trumbell, of Lawrence, Mass., and for the bridges and masonry is J. W. Burwell, of Salisbury, Mass. F. W. Bateman, of Franklin Falls, N. H., is the engineer in charge of work.

Providence & Springfield.—Wm. Tinkham, of Providence, R. I., President, writes as follows:

The Primrose Branch is projected to run from Primrose Station through North Smithfield to Woonsocket, R. I. The surveys have been completed and contracts will be let next spring. There will be a trestle at Woonsocket.

Dutchess County.—It is expected to have the section of this road from Poughkeepsie to Hopewell, N. Y., completed by Christmas. The extension from Hopewell to Lake Mahopac, surveys for which have been in progress for some time, will, it is stated, be put under construction soon.

New York, New Haven & Hartford.—The report of the Directors to be submitted to the stockholders at the annual meeting Oct. 15, says that 25 miles of double track upon the Shore Line Division between Madison and East Lyme, Conn., have been completed. The work is still in progress between East Lyme and New London, 7 miles, and between Madison and Leete's Landing 7 miles, but neither section will be completed before Jan. 1. This will leave the single track only the 10 miles between Leete's Landing and Fair Haven. East of South Norwalk, upon the New York Division, work has continued upon the four tracks. As a condition precedent all grade crossings are to be eliminated, and it is hoped that on Jan. 1 not one will remain between South Norwalk and the west line of Bridgeport. In the latter city a large expenditure will be necessary. By an arrangement with the Housatonic Railroad Company, this company is now the owner of a complete right of way through Bridgeport, but it is burdened by 28 grade crossings, and a suitable passenger station must be provided. Plans are being prepared to meet these wants.

Projects and Surveys.

Rondout Valley.—Isaac N. Cox, of Ellenville, N. Y., President, writes as follows:

The surveys have all been completed for this road, which is projected to run from Wawarsing, N. Y., via Rochester, to Rosendale, N.Y., a distance of 20 miles. The work is generally light. The principal business of the road will be in milk, flagging and mill stones, cement and the summer tourist travel to the mountains. Contracts for construction will probably be let in October. Irving Righter is Chief Engineer.

Port Jervis & Water Gap.—A project is on foot to build a railway from Port Jervis, N. Y., along the Delaware River to Water Gap, N. J. The route is through a very fertile farming country.

Lake Hopatcong.—The projectors of the proposed railway from the New York & Greenwood Lake R. R. to Lake Hopatcong, have been very successful in securing subscriptions to the stock. It is the intention to build the road from Montclair, N. J., via Caldwell, to a connection with the Central R. R. of New Jersey at Rockaway Station, but on account of the heavy work, comprising a tunnel through the heights just west of Montclair, a detour will be made for the present by building from Caldwell to Great Notch. The line from Caldwell to Montclair was partly graded some time ago.

SOUTHERN.—Existing Roads.

Cumberland Valley.—Efforts are being made by the people along the route to secure the extension of this road from Winchester, Va., to a connection with the Roanoke & Southern R. R.

Albany, Florida & Northern.—Tracklaying will soon commence on this road between Albany and Cordele, Ga.

Georgia, Southern & Florida.—The surveys for the Macon & Atlantic R. R. have been completed from Macon east to the Ogeechee River, and work is being commenced.

Richmond & Danville.—This company has instructed its engineers to make three surveys for the proposed extension from Wilkesboro, N. C., to Bristol, Tenn.

Chesapeake & Ohio.—Construction is being pushed on the line from Eagle Rock to New Castle. It is to be completed by Jan. 1, 1891.

Millen & Southern.—At a meeting of of the directors recently held it was decided to build several branches. The branches are to run from Millen, Ga., northeast to the Savannah River, 35 miles, from Sterling south, 150 miles, and from some point on the main line to Brunswick, Ga., 65 miles. Loring B. Miller, 16 Beaver St., New York City, is President.

Cape Fear & Yadkin Valley.—H. L. Frey, of Greensboro, N. C., chief engineer, writes us that the grading has been completed on the 7-mile extension from Mt. Airy to the Virginia State line. No track has been laid yet.

Albemarle & Pantego.—About 25 men are now at work on the branch of this road to Cresswell, N. C. The work is completed to within two miles of that place. The total length of the branch is 12 miles. Geo. W. Ropes was the engineer in charge of construction.

French Broad Valley.—H. M. Ramseur, of Hendersonville, N. C., Chief Engineer, writes as follows:

This road runs from Asheville, N. C., up the French Broad Valley to the South Carolina State line, with a branch from Mill's River east, via Hendersonville, to Rutherfordton, N. C., a total length of 100 miles. The route is through a fine agricultural section, and near to timber and mineral lands. The work will be generally light, with easy grades and curves. There will be three bridges across the French Broad River. All the right of way has been secured, and about $110,000 in subscriptions to bonds obtained. The principal business of the road will be in agricultural produce, timber and minerals. The surveys have been completed and the contracts let. The contractors are Lewis & Corpening, Asheville, N. C.; A. B. Fortune, Batt Cave, N. C.; A. Farmer, Jr., Hendersonville, N. C., and R. W. Allen and Cannon & Johnston, Horse Shoe, N. C. About 350 men and 110 teams are now at work, and 7 miles of the grading have been completed. Tracklaying will begin in December, and it is hoped to have the road completed by May, 1891.

Asheville & Bristol.—H. M. Ramseur, Chief Engineer, Hendersonville, N. C., writes as follows:

This road is projected to run from Asheville, N. C., where connection is made with the French Broad Valley R. R., northwest to the Tennessee State line, connecting there with the Bristol, Elizabeth & North Carolina R. R., a distance of 55 miles. The work is quite heavy; grades and curves light. The route is through a rich timber and mineral section, and the principal business will be in timber, minerals, and farm products. There will be two tunnels and one bridge. Preliminary surveys have been completed. About half of the right of way has been secured and local aid to the amount of $60,000 obtained.

Projects and Surveys.

Tombigbee.—C. E. Rodenberg, of Columbus, Miss., General Manager, writes as follows:

This road is projected to run from Columbus, Miss., to Moulton, Ala., a distance of 132 miles. About 40 miles of the route are through the Yellow Creek Valley and the remainder is mountain work. All the right of way has been secured and about $300,000 in other local aid obtained. The principal business of the road will be in coal, iron, timber and general merchandise. It is expected to complete the road during 1891. The officers are B. A. Vaughan, President; A. G. Dansy, Acting Engineer; F. M. Leigh, Secretary and Treasurer.

Chattanooga Southeastern.—This company, whose incorporation was recently noted, proposes to construct a railway from Athens, Ga., to Chattanooga, Tenn., 155 miles. J. T. Robinson, of Athens, is one of the directors

Opelika Terminal.—The articles of incorporation of this company have been filed with the secretary of state at Montgomery, Ala. The incorporators are Messrs. W. J. Sanford, S. O. Houston, N. P. Renfro, T. P. Hendmon, F. M. Renfro, J. L. Dean and J. L. Cowan, of Opelika, and R. G. Hitt, of Americus, Ga. The road is to run from Anniston, Ala., through Opelika to Fort Andrews, Fla.

Georgia, Tennessee & Illinois.—This company recently chartered in Georgia to build a railway from Talapoosa, Ga., to Chattanooga, Tenn., has filed articles of incorporation in Alabama authorizing it to construct a line from the Georgia State line to Stevenson, Ala. W. B. Thomas, Tennille, Ga., is President.

NORTHWEST.—Existing Roads.

Chicago & Eastern Illinois.—A press dispatch says:

The Chicago & Eastern Illinois Ry. Co. is making arrangements to extend its St. Louis branch from Tuscola, Ill., to Shelbyville, a distance of 41 miles, where it will connect with the Cleveland, Cincinnati, Chicago & St. Louis R. R., making a short line between Chicago and St. Louis. The contractors are on the ground, and it is expected that the work of construction will begin this week.

Chicago, Minneapolis, St. Louis & Omaha.—Rapid progress is being made on the extension from Randolph, Neb., northwest. The contractors now have forces grading all along the first 25 miles, and tracklaying will begin in about a week.

Calgary & Edmonton.—Tracklaying is now in progress on this road. About 40 miles of the roadbed are now ready for the track.

Chicago & Northwestern.—About 5 miles of the grading have been completed on the line from Whitewood to Deadwood, S. Dak., and tracklaying has been commenced. Work on the tunnel will be completed in about two weeks and it is expected to have the entire line completed by Nov. 1. The road is being laid with 75 lb. steel rails and oak ties, and is being ballasted with rock.

Jacksonville & Southeastern.—R. J. Covett, receiver, of the St. Louis & Chicago R. R., officially announces that he has made a contract under which this company assumes the operation of the St. Louis & Chicago line from Mt. Olive to Springfield, Ill.

Chicago, Milwaukee & St. Paul.—This company has purchased the Milwaukee & Northern R. R., 360 miles long.

Duluth & Winnipeg.—A press dispatch from Duluth says:

"President Fisher and other officials of the Duluth & Winnipeg R. R., between this city and Lake of the Woods, were here yesterday. Their intentions are to commence work at once. The company has offered the Manitoba Southeastern $2,000,000 for its franchise, including the land grant. The Duluth & Winnipeg people have a local charter from the Crown. If the Manitoba Southeastern people do not come to time, operations will be commenced forthwith under the local charter. It is believed that the Grand Trunk is behind the Duluth & Winnipeg. The former is very anxious to get into the north. This explains the visit last week of Sir Henry Tyler and Sir Joseph Hickson."

Projects and Surveys.

Duluth, Red Lake Falls & Northern.—Arrangements are being made to commence surveys on this road at once. The surveyors will begin work at Red Lake Falls, running to Warren, in the Red River valley, thence across the Red River and through St. Thomas, in N. Dak., into the wheat country of that State. From Red Lake Falls the road will run southeast, touching the south shore of Leech Lake and making as nearly an air line as possible to Wright, on the Northern Pacific. The company will use the Northern Pacific tracks from that point into Duluth.

SOUTHWEST.—Existing Roads.

Southern Pacific.—This company is building an extension from Thebodaux to Labadieville, La., 8 miles.—The contract for shortening the line between Langtry and Flanders, Tex., has been let, and work will begin at once. The contract includes the construction of a bridge across the Pecos River.

Missouri Pacific.—Work on the Houston, Central Arkansas & Northern R. R. has been commenced at Alexandria, La.

Projects and Surveys.

Pan-Handle, Corsicana & New Orleans.—This road is projected to run from Ft. Worth, Tex., to Alexandria, La. W. S. Johnson and Stephen Smith, of Corsicana, Tex., are the leading projectors.

Texas Iron Route.—A press dispatch from Llano, Tex., says:

Chas. E. Longcope, of Philadelphia, and L. F. McClure, of Columbus, O., are in Waco as representatives of a syndicate which has purchased a large area of territory in Llano and Mason Counties, Tex. The lands are rich in iron, lead, copper, coal, silver and gold. It is the best mineral land in the State. At present there is no railroad, and the object of the visit is to secure the co-operation of Waco in the construction of a railway from this point to Llano, through Gatesville and Lampasas. It will be called the Texas Iron Route. There is a fair prospect of success.

ROCKY MT. AND PACIFIC.—Existing Roads.

Central Arizona.—D. M. Riordan, of Flagstaff, Ariz., writes as follows:

The proposed extension of this road is to run from Lee's Ferry south to Phœnix, Ariz., with a branch to Globe, Ariz. The division from Fulton to Phœnix, will be built first. The work will be about average. There will be no large tunnels or bridges. The principal business of the road will be in lumber, mining products, copper, coal, coke, grain, cattle and wool. All of the right of way has been secured. About two miles of the grading has been completed from Fulton south. Woodbury Howe is Chief Engineer.

Golden & Denver.—Construction is in progress on this Colorado road between Golden and Denver, Colo., 22¾ miles. Edward L. Berthond, of Golden, is Chief Engineer.

Anacortes & Fidalgo City.—The contract for clearing this Washington road has been let to Austin Lathrop and work is now in progress.

Coos Bay, Roseburg & Eastern.—About 200 men are at work clearing the roadbed near Marshfield, Ore. About five miles have already been cleared and the right of way for the greater part of the line has been secured. T. R. Sheridan, Marshfield, is President.

Northern Pacific.—Col. F. H. Huestis, contractor on the Northern Pacific extension to Gray's Harbor, is reported as saying:

The grade from Tacoma to the Nesqually River is completed, and all the bridging and culverts are put in and in good order. The grade from Nesqually to Olympia is nearly finished, and that portion from Olympia to Black River junction is about half complete. The track is laid from Centralia to a point 3 miles south of Black River, and a force of men will this week lay 4 miles of track from Black River toward Olympia. This piece of road is graded and the ties distributed along the line. As soon as this work is finished, 10 miles of track will be laid from Lakeview to Olympia, and it is expected by that time to have the roadbed ready for the iron to Porter Creek. It is the intention of the company to have trains running

into Montesano by Nov. 1, 1890. Two trains and a steam shovel are at work ballasting the road from Centralia west, and the depot at that place is completed. About 1,500 men are at work between Lakeview and Ocosta, 500 of them being between the latter place and Montesano. The pile-driver began work to-day on the Wynooche River, and another will be put to work on the Chehalis River, perhaps this week.

Union Pacific.—About 2,000 men are now at work on the Portland & Puget Sound R. R. between Vancouver and Kalama, Wash. At Olympia 250 teams and a large force of men are at work on a 750 ft. tunnel and a large force is grading between Kalama and Chehalis.

Great Northern.—The clearing has been nearly all completed on the Seattle & Montana R. R. and grading is now in progress.

Seattle, Lake Shore & Eastern.—The *Pacific Lumberman* says:

The tracklaying on the northern extension of the Seattle, Lake Shore & Eastern R. R. has been completed on about 50 miles, 45 miles from Snohomish north, and from the Skagit River north for about 5 miles. Thirty miles additional have been graded ready for tracklaying, and the balance of the work is well under way. The clearing is very heavy, but the grading is comparatively light work. The grades are 80 ft. per mile, and the maximum curves are 6°. The most important bridges are at the Snohomish River, 400 ft. long; Stillaguamish River, a 240 ft. draw span; Pilichuck River, 100-ft. deck, Howe truss; Skagit River, 650-ft. combination and draw span; south fork of the Nooksack River, 250-ft. combination and span, and at the north fork of the Nooksack River, 420-ft. truss. There will be a 4,000-ft. pile trestle at the Stillaguamish, and a 7,000-ft. trestle at the Skagit River. The names of the principal contractors, and the sections awarded them through from Snohomish Junction through Snohomish, Sedro, and to the Canadian boundary, are as follows: Earle & McLeod, sections 20 to 50; J. K. Murphy, 50 to 61; P. H. Smith & Bro., 63 to 78; all of Seattle; Clements, Bradford & Co., 78 to 88; M. J. Henry, 88 to 98, both of Nooksack, Wash. The San Francisco Bridge Company has the contract for the bridges and trestles, except between the 20th and 61st miles.

FOREIGN.

Great Mexican Transcontinental.—W. T. Robertson has the contract for building the Great Mexican Transcontinental R. R. from Mayesland, on the Pacific Coast, across the Sierra Madres to Matamoras. It is stated that work will begin in two weeks on that division of the road between Matamoras and Matayuala, a distance of 350 miles. He has 400 men at work at Mayesland on the Pacific Coast division. He also has a large force of men a work on the Monterey & Mexican Gulf road.

CITY TRANSIT.

Dummy Railways.—*Columbus, Ga.*—It is reported that a line will be built from Columbus to Girard, Brownville and Phœnix City.

Marshfield, Ore.—A company is reported as incorporated to build a motor line from Marshfield through Yarrow and Empire City to South Bay. The total length of the projected line is about 10 miles.

Walla Walla, Wash.—A motor line to Milton is proposed.

Cable Railways.—*New York City.*—Work on the Broadway Cable Ry. will begin at once. The street will be paved at the same time, and all companies having mains in the street will be required to put the same in order before the new pavement is laid. It is expected that the roadway from Battery Park to Chambers St. will be finished by the beginning of winter. It is proposed to run motor cars alone over the road, no trains being used.

Dallas, Tex.—It is stated that all but 10% of the $650,000 capital stock of the Dallas Cable Railway & Construction Co. has been taken up, and that work will begin very soon.

Electric Railways.—Lines are proposed between Fort Plain and Richfield Springs, N. Y.; from Manchester to Lake Massabesic, N. H.; from Seattle to Edmonds, Wash., 14 miles in length. Extensions are proposed at Washington, D. C.

Concord, N. H.—It is reported that the street railway will lay heavier rails before their electric plant is put in operation.

Natick, Mass.—It is reported that the Electric Railway Co. will extend its track through Wellesley to Newton, which town is already connected by an electrical line to Boston.

Jamestown, N. Y.—The electric railway is reported as likely to extend its lines to Lakewood and Fulconer. The routes proposed cover 25 or 30 miles.

St. Augustine, Fla.—H. Canfield, C. D. Blauvelt and G. Old are reported to be organizing the Electric Belt Line Ry. for the purpose of laying some 6 miles of track.

Ogden, Utah.—An injunction restraining the Rapid Transit Co. from beginning work has been removed, and construction will commence on the 20 miles of proposed line.

Astoria, Ore.—It is reported that work will soon begin on the 4½ mile track proposed here.

Tacoma, Wash.—The Tacoma & Puyallup Ry., now operated by steam motors, is reported as about to introduce the storage battery system.

HIGHWAYS.

Pennsylvania.—A road will be built between McKeesport and Wilmerding, the majority of property owners along the proposed line having given their consent.

Virginia.—The U. S. Senate has passed a bill authorizing the improvement of the road running along the Potomac River in Alexandria Co.

BRIDGES, TUNNELS AND CANALS.

Bridges.—*Rockville, Conn.*—The wooden bridge at Shadd's Mills, recently destroyed by floods, will be replaced by an iron structure.

Rochester, N. Y.—The City Council has decided to construct the bridge across the Genesee River and Erie Canal at Court St. The structure will cost $160,000.

Hamilton Co., O.—The plans and specifications for the following improvements were approved by the Board of Control: Wrought iron truss bridge on West Fork road, at Bachelor's; wrought iron truss bridge on West Fork road, at Hahn's; wrought iron bridge across Sycamore creek on the Loveland and Madeira road; reconstruction of bridge on Compton road, near German road; masonry of iron bridge on West Fork road, at Bachelor's; masonry of iron bridge on West Fork, at Hahn's; repair of abutment and wing walls of bridge on Eight Mile road, near Schneider's; new superstructure and extension of abutments of bridge on Markland road at corporation line west of Cleves; new superstructure of bridge on Five Mile road, near Jacob Keinath's; repair of abutments of bridge on Eight Mile road, and new superstructure on Five Mile road, near Markley's place.

Excavating, laying, backfilling, leading and yarning.

Per ft.	Amt.	Ludwig Batt.	Dowd & Rice.	W. F. Inman.	T. M. Lesher.	H. H. Holmes.	Small & Berry.	Thielman & Co.	Geo. P. Olcott.	Donato Cuozzo.	Rooney & Bergin.
10-in. pipe	7,300 ft.	.22	.21	.29	.18	.32	.28	.33	.36	.48	.75
8-in. pipe	6,000 ft.	.22	.19	.26	.21½	.27	.26	.28	.30	.38	.75
6 in. pipe	4,200 ft.	.22	.17	.23	.25	.22	.23	.25½	.26	.28	.70
4-in pipe	8,400 ft.	.22	.15	.19	.28	.16	.20	.22½	.24	.22	.60
Setting hydrants	40	....	1.50	....	7.50	5.	5.	2.50	4.	7.50	5.
Setting 10-in. valves	4	....	1.50	....	2.50	2.	2.50	2.50	6.	2.	6.
Setting 8-in valves.	6	....	1.25	....	2.25	2.	2.50	2.50	5.	1.75	5.
Setting 6-in. valves.	5	....	1.	....	2.	2.	2.	2.	4.50	1.50	5.
Setting 4 in. valves.	20	....	.75	....	2.	2.	2.	1.75	4.	1.25	4.75
Rock excavation	....	....	3.	3.	4.	3.	2.50	3.	1.50	3.25	2.
Totals		$5,698	$4,740	$6,239	$6,379	$6,494	$6,525	$7,199	$7,852	$9,159	$18,329

Acworth, Ga.—Bids will be received until Sept. 29 for building a bridge across Proctor's Creek. Address J. M. Stone.

Houston, Tex.—Bids will be received, Oct. 25, for the construction of a 100 ft. span iron truss-bridge with trestle approaches. Henry Sherffins, Mayor.

Helena, Mont.—Bids will be received until Oct. 15, for a bridge across Ten Mile Creek. J. S. Tooker.

Tunnels.—The Pando tunnel, 245 ft. in length, on the new short line of the Denver & Rio Grande between Leadville and Red Cliff, has been completed. The headings of the tunnel were begun on July 1. The material through which it is driven is a very hard kind of gneiss rock, and will never require arching or timbering.

About 1,500 laborers will be put to work soon widening and deepening the Dismal Swamp Canal, so as to admit vessels of large class passing up and down the coast by the inland waterway. Five or six hundred men will be worked at the Deep Creek end, and the rest will be distributed along the route to South Mills, in Camden County, N. C. There are four locks on the canal, and all will be done away with but one.

WATER-WORKS.

NEW ENGLAND.

Boston, Mass.—The mayor has transmitted a request from the water board for a loan of $250,000 to be expended in the extension of mains during the year beginning Oct. 1.

East Bridgewater, Mass.—A vote will be taken on Oct. 4 to decide the question of the city purchasing the company's works.

Hamilton, Mass.—O. F. Brown, Town Clerk, has sent us the following:

No action has been taken by the town. Parties are investigating the matter and getting signatures to petitions.

Wenham, Mass.—We have received the following information from Wellington Pool:

The parties interested in the projected water supply system are getting the sentiment of this and one or two adjacent towns in regard to the matter. At present little is known about it, or what will come of the proposition. A private company will build the works if they are put in. Population, about 900.

South Manchester, N. H.—New water mains are to be laid on Charter Oak St.

MIDDLE.

Babylon, L. I., N. Y.—A citizens' vote will be taken on the question of contracting for a water supply. Two propositions for furnishing water have been received: one to lay 3 miles of pipe and set 30 hydrants at $900 per year; the other to furnish the same service at $750 per year. Supervisor Higbie or Town Clerk D. Elaugiullette can furnish information.

Dunkirk, N. Y.—Sterne Bros., of Erie, Pa., have been awarded the contract for furnishing a 150 HP. boiler to replace the one now in use.

Lancaster, N. Y.—F. H. James has sent us the following:

The company has not been incorporated; franchise merely secured. Stock books will be opened soon.

Rochester, N. Y.—Proposals will be opened on Oct. 3 for a considerable amount of pipe-laying by T. J. Neville, Clerk.

West Troy, N. Y.—Sealed proposals will be received until Oct. 6 for furnishing all labor and material, laying pipes, connections, and fittings for a water service system at the Watervliet Arsenal. Specifications and all other information can be had upon application to Lieut. Col. F. H. Parker, Ord. Dept., U. S. A.

Plainfield, N. J.—The property of the water company is reported to have been sold to John Kean, Jr., of Elizabeth, N. J. Construction work has been at a standstill for some time, but it is probable that operations will be resumed soon.

Hackensack, N. J.—See Rutherford, N. J.

Rutherford, N. J.—By the proposition of the Hackensack Water Co., of Hoboken, the borough is offered a water supply at about $15 per hydrant. Councilmen Alyea and Warner and two citizens are to investigate the plan and report to the Council. [By an error this note appeared in our last under Hackensack, N. J.—ED.]

South Orange, N. J.—Carrol Ph. Bassett, Engineer in charge, has sent us the following list of bids:

Allegheny, Pa.—Attention is again called to the advertisement in another column for establishing a complete system of water supply, furnishing supplies, etc.; bids for which will be opened on Oct. 1.

Westfield, Pa.—Secretary T. M. Leonard sends us the following:

Contracts will be let on Jan. 1, 1891, by the Westfield Water Co. President, J. H. Miller; Secretary, T. M. Leonard. No engineer has been secured as yet. The estimated cost is $30,000; $25,000 has been secured by subscriptions. Water will be furnished by springs and used for fire hydrants and domestic supply. Work is to be commenced May 1 and completed by Sept. 1, 1891. Population, 1,500.

SOUTHERN.

Berryville, Va.—We have received the following from T. S. Thompson:

Contracts will either be let on Oct. 15 or Nov. 1. Specifications will be out soon. The stock of the Berryville Water Co. has been secured. Estimated cost, $25,000. Water will be taken from springs or artesian wells and used for fire hydrants and domestic use. President, Geo. C. Thomas. Secretary, T. S. Thompson. Engineer, Alexander Gobell.

Salem, Va.—The new works are nearly completed. Water is pumped from Lake Spring to a reservoir.

Weldon, N. C.—It is reported that a franchise to build works has been granted to the Water Power Mfg. & Improvement Co. President, William Habliston, of Petersburg, Va.

Atlanta, Ga.—Hall Brothers have submitted their report to the Water Committee. They recommend that the supply be taken from the junction of Falls Creek and the West Amicolola River, at an elevation of 1,381 ft. above sea level. They estimate the maximum cost and requirements for carrying out this plan and securing 10,000,000-gall. supply immediately to be as follows:

14 miles 30-in. w. i. pipe	$231,000
70 miles canal	210,000
Dam on Amicolola River	3,000
Bridges on Etowah and Chattahoochee	40,000
Cleaning pits, valves and blow-offs	10,000
15% for engineering and contingencies	74,100
Total	$568,100

Adairsville, Ga.—Efforts are being made to secure a system of water supply.

La Grange, Ga.—The city will probably issue $50,000 of bonds for construction of water-works.

Valdosta, Ga.—Engineers Nier and Hartford, of Chattanooga, Tenn., are putting in works at this place.

De Land, Fla.—The following is from Silas B. Wright, Secretary and Treasurer of the De Land Water-Works Co.:

Jesse W. Starr, of Philadelphia, is the engineer and contractor for the new works now being put in by this company. George W. Fisher is President. They are to be completed about Dec. 1. Estimated cost, $30,000, procured by bonds. Water will be pumped from artesian wells to a stand-pipe. Population, 1,800 to 2,000.

Madison, Fla.—We have received the following:

The question of a complete system of water supply will depend upon the success of the artesian well now being sunk by J. A. Durst, of Crescent City, Fla. Population, 1,000.

Anniston, Ala.—The estimated cost of the new water supply is $300,000.

Montgomery, Ala.—The question of the city purchasing the Capital City Water Co.'s plant is being discussed.

Baton Rouge, La.—Several wells are to be sunk.

Johnson City, Tenn.—The City Council has extended the time to Jeter & Co. for the completion of the water-works to July 1, 1891.

Kimball, Tenn.—A system of works is being put in by Engineers Nier & Hartford, of Chattanooga, Tenn.

Trenton, Tenn.—George C. Morgan, of Chicago, is re-

ported to have been awarded the contract for building the new works.

Louisville, Ky.—J. Whitewood, Phillipsburg, N. J., has been awarded the contract for erecting the new standpipe.

Middlesborough, Ky.—Proposals for building a dam across the valley of Little Yellow Creek, to form storage reservoir, were received by A. A. Arthur, Vice-President of the Middlesborough Water Co., on Sept. 25. The dam will be of earth embankment, with masonry core.

Mt. Sterling, Ky.—J. W. Hedden has sent us the following:

The Mt. Sterling Water-Works Co. will construct works. Estimated cost, $85,000. President, Lewis Apperson; Vice-President, M. S. Tyler; Secretary and Treasurer, J. W. Hedden. Water will be pumped from Slate Creek to a stand-pipe. Hydrants will be used. Population, 7,000.

NORTH CENTRAL.

Findlay, O.—Bids will be received until Oct. 9 for $50,000 of 5% 30-year extension bonds, by Thomas Meehan, Mayor.

Rushville, Ind.—Sealed proposals will be received by the Common Council until Nov. 3 for the construction of a system of water-works under a franchise to be granted by the city. Mayor, Wilson T. Jackson.

Chicago, Ill.—The Addyston Pipe Co., of Cincinnati, O., has been awarded a contract for furnishing 200 tons of pipe.

Elmhurst, Ill. (A suburb of Chicago).—The following is from George C. Morgan, of Chicago:

Contracts are to be let at once. Estimated cost, $25,000. Water will be pumped from springs to a Morgan special water tower, and used for fire protection and domestic supply.

NORTHWESTERN.

Algona, Ia.—Harrison & Hawley, of St. Paul, Minn., engineers and contractors for the new works, inform us that work is to be commenced on Oct. 10 and completed by Nov. 15. The 144,000-gall. pump will be furnished by the Smith & Vaile Pump Co., of New York, and the valves, hydrants and pipe by R. D. Wood & Co., of Philadelphia, Pa.

Hampton, Ia.—Recorder Charles Krag requests us to state:

Bonds for $14,000 will be issued and sold by the city on Oct. 1, for the purpose of constructing water-works. George W. Wynn, of Cedar Rapids, Ia., has been engaged to draw the plans and specifications. None of the materials have yet been purchased.

Duluth and West Duluth, Minn.—William Craig, Superintendent, informs us that the Duluth Gas & Water Co. expects to supply West Duluth with water as soon as the franchise can be obtained from the city. The West Duluth Water Co. is now laying mains in West Duluth with the intention of connecting with those of the Duluth Gas & Water Co. as soon as the city grants permission to do so. If permission is not granted other arrangements will be made for supplying West Duluth.

St. Paul, Minn.—The following bids have been received for furnishing the new pumping machinery for the McCarron Lake station, and referred to Engineer Somers:

H. R. Worthington, of New York (bids covering two different makes of machinery), first, $24,700; second, $27,000.

Holly Mfg. Co., of Lockport, N. Y. (bids covering two different makes of machinery), first, $28,000; second, $22,500. To both of these amounts $2,000 must be added for setting boilers and arranging steam pipes.

E. P. Allis & Co., of Milwaukee, Wis., $32,000.

Topeka, Kan.—The Kansas Water Co. has been chartered to build water-works and has made application for a franchise. The incorporators are: J. B. Bartholomew, A. B. Quinton, W. A. L. Thompson, E. S. Quinton, and B. M. Curtis, of Topeka; Frederick A. Brigham, of Rhode Island, and Charles B. Fargo, of Chicago. Capital stock, $750,000.

The ordinance provides for 3,000,000 galls. of water daily taken from the Kansas River, above the insane asylum. The company is to furnish water free for all fire hydrants, providing the city will furnish and construct the hydrants.

Oswego, Kan.—The recently incorporated Oswego Water-Works Co. is a reorganization of the Oswego Water Supply Co. This company's works went into the hands of a receiver in 1887.

Hebron, Neb.—We have received the following:

Citizens have voted to issue bonds for $25,000 for establishing works. Plans and specifications are to be advertised for. After they are received, bids for constructing the works will be wanted. Water will be pumped from wells or the river to a stand-pipe.

Stromsburg, Neb.—The proposition to bond the town for $3,000 to build works has been defeated.

Wayne, Neb.—Bonds have been voted for $18,000 for putting in a system of water supply.

Canton, S. Dak.—The city will contract with any person or company for water for domestic supply and a sufficient number of hydrants to afford fire protection. For further particulars see advertising columns of our issue of Sept. 20, or address J. M. Zeller, mayor.

Vermillion, S. Dak.—A special election will be held on Oct. 9 for the purpose of voting bonds for $3,000 for a system of works.

White Sulphur Springs, Mont.—Proposals were opened on Sept. 22 for furnishing the town with a water supply. J. E. Saxton, Clerk, can furnish information.

SOUTHWESTERN.

Kirkwood, Mo.—It is reported as propable that the proposition of the Sunset Hill Electric Light, Power & Water Co., to supply the town with water from the Meramec River, will be accepted.

St. Louis, Mo.—Sealed proposals will be received until Oct. 14 for making the required excavations and building the inshore tunnel, engine pits and appurtenances at the Chain of Rocks complete in working order.

Arlington Heights, Tex.—Works are to be constructed. Address H. W. Tallant, Manager Chamberlin Investment Co., Fort Worth, Tex.

Hallettsville, Tex.—The following is from W. B. Blakeslee, City Clerk:

Contracts will be let by the city on Oct. 6 for works to cost about $15,000. Water will be pumped from Lavaca River to a stand-pipe. About 23 fire hydrants will be purchased, together with a pumping engine of 500,000 galls. daily capacity, a stand-pipe 12 ft. in diameter by 100 ft. high and 2,500 ft. of 8-in. and 4,000 ft. of 4-in. pipe. Jesse Green is Mayor. Population, 1,500.

Quanah, Tex.—The Quanah Water, Ice & Electric Light Co. has been incorporated with a capital of $75,000 to erect works.

Coal Creek, Rockvale and Florence, Col.—The Coal Creek Water and Light Co. has been incorporated at Denver to furnish water to these towns. The incorporators are: John Long, Hugh Houston, John L. Roberts, John Robertson, George A. Baker. Capital stock, $50,000. The principal office is at Coal Creek.

Del Norte, Col.—A nearly unanimous vote has been cast in favor of bonding the town for constructing works. George D. Nickett, is the Engineer in charge. He estimates the probable cost to be $21,000. A reservoir is to located on Lookout Mountain, 210 ft. above the town. Contracts will be let soon.

PACIFIC.

Pullman, Wash.—Reports state that a system of works, to cost $8,000, is to be constructed by G. W. Sutherland, of Walla Walla, Wash. Water will be pumped direct to mains and to a storage reservoir of 150,000 galls. capacity.

Astoria, Ore.—Big Creek and Young River are mentioned as sources for a new water supply.

The Dalles, Ore.—Sealed proposals will be received until Oct. 8 for furnishing about 268,000 lbs. of 10-in. wrought iron pipe, and about 170 tons of cast-iron pipe and specials; also, for laying 30,500 ft. of pipe and building a receiving basin and a 3,000,000-gall. distributing reservoir. Specifications and forms of proposals can be obtained from G. P. Low, Engineer, or M. T. Nolan, Secretary.

Provo City, Utah.—The Provo City Water-Works Co. will probably be awarded a contract for furnishing a water supply and setting 50 hydrants at $60 each per year. Samuel Liddiard is Chairman of the Council Committee.

CANADA.

Montreal, P. Q.—J. O. F. Laforest, Deputy Superintendent, informs us that the City Council has decided to roof the high service reservoir. This reservoir is 80 ft. wide, 200 ft. long and 10 ft. deep.

Collingwood, Ont.—It is proposed to expend $25,000 for improving and enlarging the water-works as soon as authority from the Provincial Council can be obtained.

Markham, Ont.—Immediate steps will be taken to proceed with the construction of works this fall, and tenders are invited for $10,000 of 5% bonds until Oct. 1.

Morrisburgh, Ont.—A small amount of new pipe is to laid.

Penetanguishene, Ont.—Tenders, by registered letter only, will be received until Oct. 1 for constructing a system of water-works. Plans and specifications can be seen at the office of Henry Jennings, Town Clerk, or at the office of the Consulting Engineer, John Galt, Toronto. Tenders to be accompanied by marked check for 5% of the amount of the tender submitted.

Toronto, Ont.—The Committee on Water-Works will receive tenders until Oct. 20 for two duplex pumping engines, each having a daily capacity of 10,000,000 galls., together with necessary boilers. Address Wm. J. Hill, Chairman Committee on Water-Works.

ARTESIAN WELLS.

Aberdeen, S. Dak.—On Sept. 17 reports stated that $3,000 was to be expended at once in putting down a well.

IRRIGATION.

Lincoln, Neb.—Two new irrigating companies have notified Secretary of State Cowdesy of their intention to reclaim the arid regions in Western Nebraska. The first is the Niobrara Irrigating & Improvement Co., with a capital stock of $250,000. The other is the Farmers' Colorado & Nebraska Ditch Co. Water is to be taken from the north fork of the Republican River.

SEWERAGE AND MUNICIPAL.

Sewers have been ordered at Montreal, P. Q.; London, Ont.; Hartford, Conn.; Troy, N. Y., 27 × 40 in. pipe; Pittsburg, Pa., 15-in. pipe, Columbus, O., 12, 15 and 18-in. pipe; Los Angeles, Cal.

Hamilton, Ont.—The City Engineer is reported to have prepared plans for 2,000 ft. of new sewers at an estimated cost of $15,000.

New York City.—Commissioner Gilroy's estimate for next year's expenses is $160,000 for repairing and cleaning the 436 miles of sewers, now on the island.

Rochester, N. Y.—A number of 12-in. pipe sewers costing $2,600 in all have been ordered. Also a 1.5 × 2-ft. stone sewer at an estimated cost of $37,000.

Buffalo, N. Y.—About 8,900 ft. of 20, 18, 15, and 12-in. pipe sewers have been ordered. The plans for the Albany St. sewer district, which includes some 836 acres with nearly 30 miles of streets, generally paved with sheet asphalt, have been presented by M. Davey and L. H. Knapp, Mem. Am. Soc. C. E.

Winston, N. C.—Newspaper reports state that Winston will probably put in a system of sewers.

Vicksburg, Miss.—Newspaper reports state that the City Council will advertise for bids for constructing sewers at an estimated cost of $200,000.

Knoxville, Tenn.—Nier & Hartford, Chattanooga, Tenn., are preparing plans for a sewerage system.

Chicago, Ill.—The Guanitans Chicago Sewage Purification Co. has been incorporated for the purpose of purifying the water in the rivers, marshes and sewers of Cook Co.

Springfield, Mo.—Nier & Hartford, of Chattanooga Tenn., are preparing plans for a sewerage system, those prepared by Col. Waring having been rejected.

Stuttgart, Ark.—A sewerage system is reported as likely to be built by the Stuttgart Improvement Co.

Denver, Colo.—The City Engineer has been directed to prepare plans for a main sanitary sewer of some length.

Paving has been ordered at Rochester, N. Y., asphalt, costing over $89,000; Columbus, O., asphalt, stone or brick; Cincinnati, O., macadam; Louisville, Ky., grading and macadamizing; Alameda, Cal. Grading alone has been ordered at Buffalo, N. Y., estimated cost, $20,000; Pittsburg, Pa.; St. Paul, Minn.

Boston, Mass.—Mayor Hart has recommended the widening of Columbus Ave., at an estimated expense of $125,000.

Providence, R. I.—Granite paving, at an estimated cost of $9,000, has been ordered. There is some talk of fixing the width of wagon tires by law.

New York City.—Commissioner Gilroy's estimate for the next year's expenses is as follows: Boulevards, roads and avenues, maintenance, $100,000; repairs and renewal of pavements, $350,000; repaving, $400,000; resurfacing, $88,000.

Newark, N. J.—Notices of intention to lay a large number of streets with granite and trap blocks, sheet asphalt, macadam and telford pavements.

Washington, D. C.—Capt. Rossell, of the engineering department, has asked for an appropriation of $685,700 for street improvements. This sum is for grading, paving and curbing purposes only.

Columbus, O.—Grading and paving with granite, asphalt or brick has been ordered on several streets.

Superior, Wis.—The Board of Public Works has reported in favor of an expenditure of $136,400 for paving.

Bonds.—***Victoria, B. C.***—The first $300,000 for a separate sewerage system was voted Sept. 18.

ELECTRICAL.

Electric Light plants are proposed at Westfield, Mass.; Stanley, Va., address the Land & Furnace Co.; Chester, S. C.; Charleston, S. C., address the Charleston Electric Light & Power Co.; Washington, Ga., address the Excelsior Mfg. Co.; Titusville, Fla.; Greenville, Tex.; Pinckneyville, Ill.; Berlin, Wis.

Jamaica, L. I.—Bids recently received for lighting the streets with 32 cp. incandescent lamps ranged from $17.50 to $19 per lamp. The National Electric Mfg. & Construction Co. were awarded the contract at the former figure.

Jonesboro, Tenn.—Electric lights will probably be introduced, the current being supplied by the Watauga Light & Power Co., of Johnson City, Tenn. The distance from the light station to Jonesboro is some 7 miles.

New Companies.—Eagle Electric Co., New York city; capital stock, $200,000; incorporators, David May, J. B. Allaire, Benj. Skinhardt. Catskill Illuminating & Power Co., Catskill, N. Y.; capital stock, $45,000; incorporators, J. A. Cooke, E. Lampman, J. I. Weiner and others. Faraday Heat, Light & Power Co., Morton, Pa.; capital stock, $35,000; W. J. Bankard, Secretary. Shippensburg, Pa., Electric Light, Heat & Power Co.; capital stock, $5,000; incorporators, G. W. Thrush, J. C. Rummell, C. J. Reddig and others. Oakland, Md., Electric Light & Power Co.; capital stock, $7,000; incorporators, S. T. Jones, J. L. McComas, E. H. Sinell. Orangeburg, S. C., Electric Light & Power Co.; Secretary, Chas. Capes. Waynesboro, Ga., Electric Light Co.; capital stock, $7,500; incorporators, A. G. Whitehead, P. L. Corker and others. Sunset Hill Electric Light, Water & Power Co., St. Louis, Mo.; capital stock, $10,000; incorporators, M. Bernheimer, H. Tuholske and S. M. Lederer. Whiteside & Fuller Electric Mfg. Co., Chicago, Ill.; capital stock, $100,000; incorporators, W. H. Whiteside, W. H. Pettibone, W. D. Carlile and others.

CONTRACTING.

Dredging.—***Tompkinsville, N. Y.***—Recent bids for removing 1,000 cu. yds. at the lighthouse depot were at 35 and 37½ cts. per cu. yd.

Philadelphia, Pa.—The bids for removing the islands in the Delaware River, near Philadelphia, were as follows:

	Dredging and removing earth to League Island.	Any other place.	Removing sea wall
	Per cu. yd.		Per cu. yd.
F. C. Somers	23 cts.	21 cts.	$4.40
Baltimore Dredging Co.	22¼ cts.	20¼ cts.	$4.50
American Dredging Co	16¾ cts.	16¼ cts.	$4.00
Penn. Dredging Co.	17 cts.	15 cts.	$2.50

Cement.—*New York City.*—Recent bids received by the Dock Dept. for 500 bbls. quick setting Portland cement ranged from $2.50 to $3 per bbl.; for 500 bbls. slow setting cement from $2.33 to $2.70 per bbl.

Sewers.—*St. Louis, Mo.*—Wycoff and Crean have received a $44,230 sewer contract.

Kansas City, Mo.—The $50,000 sewer contract recently taken by P. McDonald has been given up by him, as there is considerable doubt as to the legality of the taxes with which the work was to be paid.

Trestle Work.—Binder & Seifert, Civil Engineers and Contractors, 803 Royal Insurance Building, Chicago, Ill., have been awarded the contract for constructing an iron trestle at Akron, O., for the P. A. & W. R. R. The trestle is to be 1,100 ft. long. Contract price, $33,000.

Granite Paving.—*Troy, N. Y.*—Recent bids ranged from $3.05 to $3.40 for paving, 75 to 85 cts. for new curbing, 10 to 18 cts. for old curbing.

Asphalt Paving.—*Syracuse, N. Y.*—The Warren-Scharf Asphalt Paving Co. has received two contracts amounting to $81,786.

Street Improvement.—*Peoria, Ill.*—Recent bids for improving gravel roads were 27 cts. per cu. yd. for excavation; gravel, 71 to 73 cts. per cu. yd.; brick gutter, $1.55 per sq. yd.; cobble gutter, 65 cts. per sq. yd.

San Francisco, Cal.—A recent contract was let at the following rates: Basalt blocks, 22½ cts. per sq. ft.: stone curb, 10 × 12 in., $1.04½ per lin. ft.; wooden curb, 10 × 12 in., 29 cts. per lin. ft.; relaying basalt blocks, 3½ cts. per sq. ft.

Sewerage System.—*Somerville, N. J.*—Bids recently received for sewer work ranged as follows: 2,930 ft. 15-in. pipe at $.97 to $1.80; 120 15-in. Y's at $.47 to $2.00; 560 ft. 12 in. pipe at $.87 to $1.80; 20 12-in. Y's at $.64 to $2.55; 780 ft. 10-in. pipe at $.60 to $1.40; 30 10 in. Y's at $.25 to $1.77; 1,770 ft. 9-in. pipe at $.55 to $1.25; 70 9-in. Y's at $.45 to $.85; 11,530 ft. 8-in. pipe at $.45 to $1.15; 460 8-in. Y's at $.17½ to $1.20; 875 ft. 24-in. pipe at $1.48 to $2.25; 1,300 ft. 20-in. pipe at $1.20 to $2; prices for manholes, basins and tanks varied greatly. The total bids ranged from $17,576 to $31,395. Carrol Ph. Bassett is engineer in charge of the work.

PROPOSALS OPEN.

Sewers.—*New York City.*—T. F. Gilroy, Sept. 29.

Washington, D. C.—Concrete and brick. J. W. Douglass, District Commissioner, Oct. 4.

St. Louis, Mo.—Complete system in District 4, embracing a large number of sewers from 8½-ft. brick to 12-in. pipe. G. Barnet, Oct. 7.

Denver, Colo.—Sanitary sewer of considerable size. F. B. Crocker, Oct. 17.

Streets.—*Washington, D. C.*—Asphalt paving. E. Clark, Architect U. S. Capital. Oct. 4.

St. Paul, Minn.—Grading. R. L. Gorman, Sept. 30.

Dredging.—*New York City.*—About 16,000 cu. yds., Oct. 3; 10,050 cu. yds., Oct. 6. Dock Dept.

Erie, Pa.—About 100,000 cu. yds. sand and gravel. T. Road, Chief Eng. Pennsylvania Co., Pittsburg, Sept. 30.

Excavation.—*Lawrence, Mass.*—About 125,000 cu. yds. sandy gravel. J. W. Crawford, Oct. 1.

Approaches to Dry Dock.—*Norfolk Navy Yard.*—N. H. Farquhar, Bureau Yards and Docks, Washington, D. C., Oct. 15.

Water Works.—*Berryville, Va.*—Complete system, Oct. 15.

St. Louis, Mo.—Inshore tunnel, engine pits, etc. G. Barnet, Oct. 14.

Water Pipe.—*Dalles City, Ore.*—About 134 tons 10-in. wrought and 170 tons cast-iron pipe and special castings. Also bids for laying 30,500 ft. of pipe and building a receiving basin of 3,000,000 galls. capacity. G. P. Low, Oct. 8.

Sea Wall.—New York City Health Dept. Sept. 30.

Piling and Capping.—*Navy Yard, Norfolk, Va.*—For marine railway, N. H. Farquhar, Bureau of Yards and Docks, Washington, D. C. Oct. 8.

Machine Tools.—*Boston and Portsmouth Navy Yards.*—Planers, bending rolls, shapers, punchers and shears, milling machines, radial drills, hydraulic jacks, beam and angle setting and bending machines. Ed. Stewart, Paymaster-General, U. S. N., Washington, D. C. Oct. 7.

Court House.—*Anderson, Tex.*—Stone or brick. Larmour & Watson, Austin, Tex. Oct. 15.

Connecting Pumps.—*Norfolk, Va.*—Connecting new pumps with old dry dock. N. H. Farquhar, Washington, D. C. Oct. 8.

Grading.—*Boston, Mass.*—Park Department. Oct. 6.

Brookline, Mass.—A. H. French. Oct. 6.

MANUFACTURING AND TECHNICAL.

Cars.—The South Baltimore Car Works have an order for 500 box cars, 36 ft. long, fitted with automatic couplers and air brakes, for the Baltimore & Ohio R. R. The Litchfield Car Works have an order for 500 coal cars for the Wabash R. R. The United States Rolling Stock Co., Decatur, Ala., has an order for 200 fruit cars for the Georgia Southern & Florida R. R., and for 60 flat and 10 stock cars for the New Orleans & Northwestern Ry.

Locomotives.—The New York, Providence & Boston is having a 10-wheel locomotive built at the Manchester, N. H., Locomotive Works. It is to have 19 × 26 in. cylinders, wagon top boiler of ⅛-in. steel, 56 ins. in diameter, with 236 2-in. flues. The fire-box is 6 ft. 6 ins. long, and 2 ft. 11 ins. wide inside. The driving wheels are 5 ft. 3 ins. in diameter, and will carry 46 tons, the total weight of the engine being 57 tons. The tender will hold 3,500 galls. of water. The Louisville, New Albany & Chicago Ry. has contracted with the Rogers Locomotive Works for 4 freight engines, which, with the 5 passenger engines recently ordered, will be delivered within the next 60 days. The Rio Grande Western R. R. has placed an order for 8 freight locomotives with the Baldwin Locomotive Works and for 4 passenger engines with the New York Locomotive Works. Among recent orders received by the Baldwin Locomotives Works are 30 for the Manhattan, 32 for the Union Pacific, 27 for the Northern Pacific, 48 for the Denver & Rio Grande, 12 for the Chicago, Rock Island & Pacific, and 20 for the Baltimore & Ohio lines. Of the latter, 3 will be high-speed passenger locomotives with cylinders 20 × 24, and driving-wheels 78 ins. in diameter.

The Westinghouse Machine Co. made sales during August of 87 engines, with an aggregate horse power of 4,640. Among these sales may be mentioned one 80 HP. compound, for France; one 100 HP. compound, for Galveston Street Ry. Co., Galveston, Tex.; two 100 HP. compound, Terre Haute Street Ry. Co., Terre Haute, Ind.; one 200 HP. standard, Elgin National Watch Co.; 150 HP. compound, Sawyer-Man Electric Co., New York; one 150 HP., compound, C., B. & Q. R. R., Chicago, and one 80 HP., compound, Media Electric Co., Media, Pa. The July sales amounted to 95 engines of 5,615 HP. Foreign orders during the month included Germany, Australia, Bavaria, Spain, Cuba, Mexico and Nova Scotia.

The E. P. Allis Co., of Milwaukee, has a contract to make 9 engines of 1,000 HP. each to furnish the power in operating the West End Street Ry., of Boston.

The Westinghouse Electric Manufacturing Co. is reported as intending to erect works near the shops of the Pullman Palace Car Works, at Pullman. It is stated that the works will cost between $400,000 and $500,000 and employ 2,000 men.

The Thomson-Houston Mining Cars are used at the Erie Colliery of the Hillside Coal Co. at Scranton, Pa. A 50-HP. dynamo wound for a P. D. of 220 volts is used. The wires run down the shaft inside of gas pipes for protection, and are carried overhead through the galleries. Connections are made at suitable intervals, and a portion of the current is utilized for lighting purposes, two 110-volt lamps being placed in series. The rails are used as conductors for the return current. The length of the locomotive over all is 9 ft. 7 in.; width, 5 ft. 3 in., and height, 5 ft. 6 in. This last dimension can be considerably reduced by placing the rheostat at one end instead of on the top, as has been done in the present instance. The weight of the locomotive is 10,500 lbs., to which 1,800 lbs. have been added to increase traction. The motor employed is of 40 HP. During a period of 11½ days the average number of cars delivered at the shaft bottom by the locomotive was 559.5, against 526.95 per day delivered by mule haulage. To deliver 700 cars per day of 10 hours the time of running the locomotive would be 5 hours and 30 minutes, leaving 4 hours and 30 minutes for contingencies. The total distance run would be 21.28 miles, and the locomotive would be reversed 232 times.

New Engine Works.—It is reported that large engine and boiler works will be built at Buena Vista, Va. by a company of which A. K. Rorig is President and J. H. Mullin, Secretary. Newspaper reports say that the company will build a 125 × 200-ft. foundry, a 50 × 175-ft. pattern shop, an 87 × 175-ft. cleaning shop, a 50 × 100-ft. smith shop, a 125 × 300-ft. machine shop, a 125 × 200-ft. boiler shop and a 40 × 70-ft. engine room.

The Springfield Iron Co. has rebuilt its track bolt works burned last July, and has resumed operations. Advantage has been taken of the rebuilding to thoroughly remodel the shops.

The Westinghouse noiseless motor has been tested with considerable success, it is said, at Pittsburg, Pa. As is well known, the noise of a car in motion is made by the rapid rotation of the gear wheels of the motor. The idea of the Westinghouse patent is to leave the wheels inclosed in an air-tight box with the gear wheels immersed in lubricating oil. The test proved that the idea was a good one so far as deadening the noise was concerned.

A dam across the Missouri River, near Helena, Mont., is reported as probable. It will probably be a timber crib structure 47 ft. high and 800 ft. long. The water will be taken from above the dam through rock tunnels to turbines geared to dynamos. The power thus developed will be transmitted to Helena, some 13 miles distant.

The Muskegon Iron & Steel Co., Muskegon, Mich., will, it is said, soon build an open hearth steel plant and bridge shop. The company is now completing its rolling mill, which will start with one 18-in. and one 9-in. 3-high train of rolls.

The Westinghouse Air Brake Co. will remove its Allegheny offices to Wilmerding, Pa., where the new plant of the company is located.

Levees will be built along the east bank of Los Angeles River, Cal., by the Los Angeles Terminal Ry., in consideration of a grant of land and right of way by the city.

Car Works.—The Mt. Vernon, Ill., Car Works have been opened and orders for several hundred cars have been filed. About 700 men are regularly employed. The Chase Refrigerator Car Co. will build works at Kansas City, Kan., employing 200 men. It requires 6,000 refrigerator cars to handle the beef from Kansas City, and the company expect to make a large saving by locating their shops there.

Buildings.—The Winona & Southwestern Ry. will build a station at St. Charles, Minn. A union passenger station and freight yard will be built at La Grange, Ga., by the roads passing through the city. The Lake Shore line has decided to construct buildings at Ashland, Ironwood, Hurley, Kaukena and other places for the use of its employés. A court house costing $100,000 is proposed at Decatur, Ill., by the Supervisors of Macon Co., Adair Co., Ia., will build a $25,000 court house.

The Chicago, Milwaukee & St. Paul Ry. will probably build a large freight depot at West Duluth and a round house at Yankton, S. D.

New Companies.—The National Unicycle Elevated Railway Construction Co., East St. Louis, Ill.; capital stock, $5,000,000; incorporators, R. E. Maddox, J. P. Taylor, and others. Collapsible Railway Car Co., Chicago, Ill.; capital stock, $100,000; incorporators, L. C. Zolk, H. F. Sanders, J. T. Richards. Bonzano Metallic Railroad Tie Co., incorporated in New Jersey with $1,000,000 capital stock. Smillie Coupler and Mfg. Co., Newark, N. J.; capital stock, $100,000. Walker Automatic Car Coupler Mfg. Co., East St. Louis, Ill.; capital stock, $300,000; incorporators, W. J. Walker, L. Hammerschmidt, and I. N. W. Kerr. Peconga Natural Gas and Land Improvement Co., Marion, Ind.; capital stock, $1,000,000; incorporators, W. B. Dodds, J. D. Oakford, G. A. Henry, and others. St. Louis, Mo., Tricycle Railway Co.; capital stock, $200,000; incorporators, E. M. Turner, C. H. Wingler, J. H. French, and others. Bluffton, Ala., Car Wheel Co. Northwestern Equipment Co., Chicago, Ill.; capital stock, $500,000; incorporators, M. S. Frost, S. A. Stevens, E. I. Frost.

Lewiston, Me., Gas Light Co.; incorporators, W. H. White, E. C. Lee, R. Morgan, and others. Maine Asphalt Roofing & Paving Co., Portland, Me.; capital stock, $10,000; incorporators, L. W. Tibbetts, A. C. Libby, P. J. Larrabee, and others. O'Donnell Elevator Co, Cleveland, O.; capital stock, $25,000; incorporators, G. M. J. O'Donnell, H. Board, W. C. Smith, and others. Central Oil & Gas Co., New Baltimore, O.; capital stock, $25,000. Empire Iron Co., Duluth, Minn.; incorporators, A. T. Scarlet, N. Hall, S. F. White, and others; capital stock, $200,000. Humbert Nut Lock Co., Basic City, Va.; capital stock, $10,000; T. Bissel, Sec'y. Stark Car Motor & Mfg. Co., Chicago, Ill.; capital stock, $25,000; incorporators, J. H. Raymond, O. R. Barnett, P. R. Shumway. Chicago Electrical Supply Co., Chicago, Ill.; capital stock, $100,000; incorporators, H. B. Hallock, C. P. Chapman, F. W. Parker

Metal Market Prices.—*Rails*—New York: $30 to $30.50; for old iron rails, $26. Chicago: $33.50; old rails, $27 for iron, $18.50 to $22 for steel. Pittsburg: $31 to $31.50; old rails, $28 to $28.25 for iron; $21.50 to $22 for steel.

Foundry Pig-iron.—Chicago: $15.50 to $17.50. Pittsburg: $15.50 to $17.50. New York: $16 to $18.

Track Materials.—New York: steel angle bars, $1.80 to $1.95; spikes, $2.20 to $2.25; track bolts, 2.95 to 3.10 cts. with square, and 3.10 to 3.15 cts. with hexagon nuts. Pittsburg: splice bars, 1.95 to 2.05 cts. for iron, 2 to 2.1 cts. for steel; spikes, 2.2 cts.; track bolts, 2.85 with square, and 3 cts. with hexagon nuts. Chicago: splice bars, 2.25 cts. for steel, and 2.05 to 2.15 cts. for iron; spikes, 2.2 to 2.25 cts; iron track bolts $3.15 with hexagon nuts.

Pipe.—Cast-iron, $27 to $30 per ton. Wrought iron, discounts as follows: 47½ and 40 per cent. on black and galvanized butt-welded; 60 and 47½ on black and galvanized lap-welded. Casing, 50 per cent.

Lead.—New York, 4.55 to 4.65 cts.; Chicago, 4.85 to 5.05 cts.

Structural Material.—Pittsburg: angles, 2.25 cts.; tees, 2.8 to 2.85 cts.; beams and channels, 3.1 cts.; sheared steel bridge plates, 2.65 to 2.7 cts.; universal mill plates, 2.35 cts.; refined bars, 1.9 to 2 cts.; steel plates, 4.25 to 4.75 cts. for fire box; 3.1 to 3.2 cts. for flange; 2.9 cts. for shell, 2.5 to 2.55 cts. for tank. New York: beams, 3.10 cts.; plates, 2.25 cts.; angles, 2.1 to 2.25 cts.; tees, 2.6 to 2.7 cts.; channels, 3.1 cts. Chicago: angle, 2.35 to 2.4 cts.; tees, 2.9 to 3.0 cts. beams, 3.2 cts.; universal plates, 2.45 to 2.55 cts.

Constructing Sewers.

Sealed proposals will be received at the office of the City Auditor of the city of Dayton, until 12 o'clock noon, Monday, Oct. 13, 1890, for furnishing material and constructing about 12 miles of brick and pipe sewers, according to plans and specifications on file in the office of the City Civil Engineer.

Forms of proposals, copies of the specifications and instructions to contractors may be obtained at the office of the Board of City Commissioners or City Civil Engineer in Dayton, O., and at the office of Cady Staley, engineer of sewers, at Cleveland, O.

Plans and specifications may be seen at the office of the City Civil Engineer in Dayton, O., after Sept. 30, 1890.

The board reserves the right to reject any or all bids.

By direction of the Board of City Commissioners. G. C. WISE, President.

C. A. HERBIG, City Auditor. 39-2t

City of Toronto, Canada.

TENDERS FOR PUMPING ENGINES.

Notice is hereby given that the Committee on Water-Works of the municipal corporation of the City of Toronto will receive tenders, addressed to the undersigned, by registered post only, up to the hour of 12 o'clock noon on Monday, Oct. 20, 1890, for two pumping engines of the duplex type, each having a daily capacity of 10,000,000 gallons, together with necessary boilers for same, the whole to be in accordance with the general specifications, which may be obtained at the office of the superintendent of the department, City Hall, Toronto.

The tenders are received subject to the approval of the properly qualified electors being obtained to a by-law providing the necessary funds.

The lowest, or any, tender not necessarily accepted.

WM. J. HILL,
Chairman Committee on Water-Works.

CITY HALL, TORONTO, Sept. 19, 1890.

39-1t

Rushville, Ind., Water-Works.

Sealed proposals will be received by the Common Council of the City of Rushville, Ind., until 12 o'clock M. Nov. 3, 1890, under a franchise to be granted by said city, for the construction of a system of water-works.

A copy of said proposed franchise may be had on application to the Mayor of said city.

Security good for $500 must accompany each bid, either in money, certified check or bond signed by known parties, as a guarantee of good faith, the same to be returned when proposal is rejected or accepted and a satisfactory bond deposited with the Common Council of said city.

The city does not bind itself to accept the lowest or any bid.

WILSON T. JACKSON,
39-2t Mayor.

Notice to Contractors.

OFFICE OF THE COURT OF BURGESSES OF THE BOROUGH OF NORWALK, CONN.

Sealed proposals will be received at the Office of the Chairman of the Street Department, No. 29 Wall St., until 11 o'clock A. M. sharp of Wednesday, Oct. 8, 1890, for the construction of a Telford MacAdam road of about 3,000 ft. in length.

All excavation necessary is to be done by the contractor. Also the crushed stone to be used in the work, and a steam road roller are to be furnished by him. Profile and specifications can be seen, and all information obtained of C. N. Wood, Engineer, or of the Chairman of the Street Department, on and after Oct. 2, 1890.

The Court of Burgesses hereby reserve the right to reject any or all bids, or to accept any that in their judgment will be for the best interests of the Borough.

Bonds satisfactory to the Court in amount will be required of those to whom the contract may be awarded.

Cash, or a certified check made payable to the Treasurer of the Borough to the amount of $300 must accompany each bid, as a guarantee that in case the contract is awarded the party will, within three days after notification of award, execute said contract. All checks will be returned to the bidders submitting proposals as soon as the contract is awarded. Proposals must be endorsed upon the outside of the envelope with the name of the bidder, and marked proposal, and addressed to E. N. Sloan, Chairman of Street Committee.

E. N. SLOAN,
ISAAC BOWE,
E. S. ADAMS, } Street Committee.
39-2t

S. E. NORRIS, Prest. JNO. E. WARE, Secy. and Treas. R. F. CARTER, Supt.

The Anniston Pipe Works,

MANUFACTURERS OF

CAST IRON WATER AND GAS PIPE,

ANNISTON, - - - - ALA.

Especially adapted for the Elevation of Clear, Gritty, Thick, or Acidulous Liquids, Quickly, Cheaply and Efficiently

PATENTED U. S. AND CANADA.

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without Engine, Machinery, Oil, Expensive Power, Skilled Labor, or Material Wear. Send for Illustrated Catalogue.

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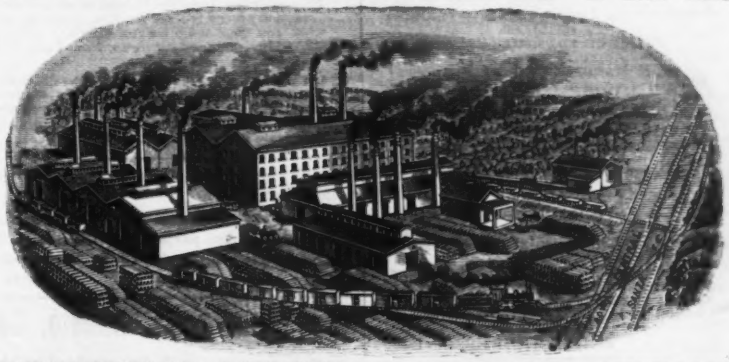
DOUBLE STRENGTH
SEWER & CULVERT PIPE.



MONMOUTH MINING & MFG. CO., MONMOUTH, ILL.

To all Whom it May Concern.

Whereas, The Common Council of the city of Dunkirk at a regular meeting thereof, held at the council room in said city on the 16th day of September, 1890, did resolve to Macadamize the roadway in that part of Lion St. lying between Third and Fourth Sts. to the width of forty (40) ft., together with the necessary curbing, guttering and cross-walks, excepting such portions thereof as are occupied by the Dunkirk and Fredonia St. R. R. Co.;

And whereas said Common Council did at the same time and place direct the city clerk to advertise in the city paper and in some general contractors' paper for bids for the materials and labor necessary for the carrying on of such improvement.

Now, therefore, Take notice that any and all persons desiring or willing to furnish the necessary materials for the said improvement and to do the said work, are hereby invited to make proposals therefor and seal them and deliver them to the undersigned at his office in said city.

Also, further Take notice, that any person desiring to bid on said work and materials, by application to the expert Civil Engineer, George D. Baker, Dunkirk, N. Y., will be furnished with complete specifications showing the work to be done, the materials to be furnished and the form and manner in which such work must be done and the materials used.

The bids must be delivered to the undersigned on or before Friday, Oct. 3, 1890, at 7:30 o'clock P. M., at which time such bids will be opened and read in public by the Mayor and Common Council assembled.

The Common Council reserves the right to reject any and all proposals.

EDWARD MADIGAN, City Clerk.

Dated DUNKIRK, N. Y., Sept. 18, 1890. 38-2t

Proposals for Iron Bridge.

Sealed proposals will be received at our office until 2 P. M. Saturday, Oct. 4, 1890, for the erection of an iron bridge on West Fifth Ave., in this city, in strict accordance with the specifications and drawings, copies of which can be seen in the office of the City Engineer. Bids will also be allowed upon plans which shall be in accordance with the general specifications, but no bid will be accepted except from bridge manufacturing companies. The right is reserved to reject any and all bids.

BOARD OF PUBLIC WORKS,
38-2t. Knoxville, Tenn.

Proposals for Grading, Improving and Macadamizing County Roads, in the County of Richmond.

Sealed proposals will be received at the place of meeting of the Board of Supervisors of Richmond County, N. Y., at the Village Hall, Stapleton, S. I., until Monday, Oct. 13, at 3 30 P. M., as follows:

For grading and otherwise improving county roads in accordance with maps, profiles and specifications on file in the Engineer's office. The quantity of work to be done is as follows:

TELFORD PAVEMENT.

Total length, miles	2 9 7 10
No. square yards, pavement	195,000
No. cubic yards, excavation	71,000

REPAIRS TO MACADAMIZED ROADS.

Total length, miles	3 8-10
No. square yards, repairs	65,000
No. cubic yards, broken stone required	3,600

TRAP OR GNEISS BLOCK PAVEMENT.

Old New York blocks can be used.

Total length, miles	1 9-10
No. square yards, pavement	35,250
No. cubic yards of excavation	7,000

Plans and specifications and also the conditions under which said proposals or bids shall be received, may be examined at the office of William S. Bacot, Engineer of County Roads, Old Village Hall, Stapleton, S. I.

Printed copies of the specifications and contract and also conditions under which said proposals or bids shall be received, may be had at the office of aforesaid Engineer.

The right to reject any or all bids for said work is reserved by said Board of Supervisors of Richmond County, as may be deemed for the best interests of the County, and notice is hereby given that the bids will be publicly opened at the meeting of the Board of Supervisors, to be held at the time and place above given.

By order of the Board of Supervisors.

CHARLES M. TODD,
Dated Sept. 15, 1890. Clerk, *pro tem*,
P. O. Address, Tompkinsville, S. I.
38-3t

Notice to Contractors.

Proposals for macadamizing several streets will be received by the Village of Mt. Vernon, N. Y., up to Sept. 30. Plans and specifications can be seen at office of Commissioner of Public Works, Mt. Vernon, N. Y.

JARED SANDFORD,
38-2t Village President.

To All Whom it May Concern.

Whereas, the Common Council of the City of Dunkirk, at a regular meeting thereof, held at the Council Room, in said city, on the 16th day of September, 1890, did resolve to macadamize the roadway in that part of Central Avenue lying between Third street and Fifth street to the width of forty (40) feet, together with the necessary curbing, guttering and crosswalks, excepting such portions thereof as are occupied by the Dunkirk and Fredonia Street Railroad Company;

And whereas, said Common Council did at the same time and place direct the City Clerk to advertise in the city paper and in some general contractors' paper, for bids for the materials and labor necessary for the carrying on of such improvement;

Now, therefore, Take notice, that any and all persons desiring or willing to furnish the necessary materials for the said improvement, and to do the said work, are hereby invited to make proposals therefor, and seal them, and deliver them to the undersigned at his office in said city.

Also, further, Take notice, that any person desiring to bid on said work and materials, by application to the expert civil engineer, George D. Baker, Dunkirk, N. Y., will be furnished with complete specifications, showing the work to be done, the materials to be furnished and the form and manner in which such work must be done and the materials used.

The bids must be delivered to the undersigned on or before Friday, Oct. 3, 1890, at 7:30 o'clock P. M., at which time such bids will be opened and read in public by the Mayor and Common Council assembled.

The Common Council reserves the right to reject any and all proposals.

Dated Dunkirk, N. Y., Sept. 18, 1890.

38-2t EDWARD MADIGAN, City Clerk.

To Masonry Contractors.

AMERICUS, GA., Sept. 16, 1890.

Bids will be received for the construction of four (4) brick piers, with pile foundations, on the Savannah, Americus & Montgomery Ry., till Oct. 10.

Apply for plans and specifications to

J. C. WRIGHT,
38—2t Engr. in Charge.

Artesian Well.

Sealed proposals will be received by the undersigned at the City Hall, Galveston, Texas up to 12 o'clock, noon, of Thursday, Sept. 25, A. D., 1890, for the boring of an artesian well, in the City of Galveston, to a depth of 3,000 ft., unless satisfactory water is procured at a lesser depth. Bidders to give price per foot for finishing with 6-in., 8-in., 10-in. and 12-in. pipe respectively. The right to reject any or all bids is reserved. THOS. W. JACKSON,

35 5t Chairman of Special Committee.

For Sale---Water-Works.

Located in Central New York, in a fine village of about 2,000 inhabitants. Supply from springs by gravity; everything first class and doing profitable business. Address

WATER-WORKS,
38-4t care of ENGINEERING NEWS.

To Contractors.

I desire bids for the erection of about 100 miles of private telegraph line over a rough mountain country. For particulars address

FRANK MATHEWS,
Chief Engineer K. I. C. & D. Co.,
39-2t Pineville, Ky.

Tile Sewers.

Bids for 4,500 lineal feet tile sewers will be received until 12 o'clock M. of Oct. 6, 1890. Address M. TSCHIRGI, JR., City Engr.

39-1t Dubuque, Ia.

U. S. ENGINEER OFFICE, Room 62, Army Building, New York, Sept. 24, 1890. Sealed proposals in triplicate will be received at this office until 12 o'clock noon, on October 25, 1890, for furnishing materials and constructing a pile wharf at Sandy Hook, N. J. The attention of bidders is invited to Acts of Congress approved Feb. 26, 1885, and Feb. 23, 1887, Vol. 23, page 332, and Vol. 24, page 414, Statutes at Large. For specifications, blank forms and all information, apply to the undersigned.

G. L. GILLESPIE, Lieut. Col. of Engineers.
39-4t

"THE WELLS LIGHT"

WALLWORK & WELLS' PATENTS. (Registered Title.)

USES KEROSENE OIL.

Obtainable Everywhere.

ESPECIALLY ADAPTED —FOR— CONTRACTORS' NIGHT-WORK.

800 and 2,000 CANDLE POWER

REQUIRES NO ENGINE OR AIR COMPRESSOR to drive it as "others do."

(Copy.)
SAVANNAH, AMERICUS & MONTGOMERY RAILWAY.
OFFICE OF THE CHIEF ENGINEER,
AMERICUS, Ga., Aug. 8, 1890.
R. E. HARDAWAY, Chief Engineer.

Messrs. Keegan & Halpin, 46 Washington Street, New York City:

DEAR SIRS: I used four of your lights for steam shovel work at night some time since and they gave entire satisfaction.

Yours very truly,
B. E. HARDAWAY, C.E.

(Copy.)
WEST VIRGINIA IMPROVEMENT CO.
WESTON, W. Va., June 24, 1890.

Messrs. Keegan & Halpin, 46 Washington Street, New York:

GENTLEMEN: Replying to your favor of 21st inst., the light you sent us has thus far given satisfaction, and I can see no chance for improvement in it.

Yours truly,
J. A. FICKINGER, Ch. Eng.

WRITE FOR CIRCULAR.

THE "WELLS LIGHTS"

Are in use on the following Railroads:

Pennsylvania,
Lehigh Valley,
Erie,
West Shore,
Del., Lack. & West.,
Norfolk & Western,
Atlantic Coast Line,
N. Y., Prov. & Bost.,
W. N. Y. & Penn.,
Michigan Central,
Union Pacific,
Southern Pacific,

And **40** others.

ALSO USED BY

Moffett, Hodgins & Clarke;
Washburne, Shaler & Washburne;
Carkin, Stickney & Crane;
C. H. & F. T. Dunbar;
Ryan & McDonald;
Prentice Brown Stone Co.;
Drake & Stratton;
Union Bridge Co.;
Berlin Bridge Co.,
And many others.

NEW HAND PATTERN WELLS LIGHT.
500 Candles, ½ gall. per hour.

KEEGAN & HALPIN

44 and 46 WASHINGTON STREET NEW YORK.

SITUATIONS VACANT.

WANTED.—A bridge draftsman, must have had at least a year's experience at work in this country. Apply to PENN BRIDGE CO., Beaver Falls, Pa. 38-2t

WANTED.—A competent engineer to make survey and map of the town of Martinsville, Va., containing 464 acres; boundary lines, streets, streams and railroads only need be retraced; other information necessary for map can be obtained without a re-survey. The above will be open for propositions until Oct. 4, 1890. Address J. E. GREGORY, Martinsville, Va. 39-1t

WANTED.—Mechanical engineer, with experience in railroad shops, to take charge of manufacture of automatic couplers; state experience and salary expected. Address "ENGINEER," Post-Office, Troy, N. Y. 39-1t

WANTED.—A thorough, good and energetic bridge erection foreman to erect the following spans 13 spans of 98 ft.; 2 spans of 148 ft., 1 draw span 288 ft., and 1 span of 63 ft.; all pin connected and through spans. Address, with references, the G. & J. Brown Mfg. Co., Belleville, Ontario, Canada. 39-2t

WANTED.—A first-class draughtsman for bridges and roofs; must be thoroughly experienced in details, strains and estimating; good salary paid to good man; no other need apply. Also, a good junior draughtsman, with at least one year's experience at bridge work, who is clever with his pen. Address, with references, to "BRIDGE WORKS," care of Engineering News. 39-4t

MISCELLANEOUS.

WANTED.—To sell back volumes of London *Engineering*. Have also number of odd numbers, loose, and several indexes for sale. State dates of what you need and price you will pay. Address "F. A. P.," Engineering News, New York. 39-2t

WANTED.—G. J. Baer, New Russell House, Key West, Fla., wants the names of some firms that are manufacturing vitrified paving brick somewhere on a stream or sea coast from where they could be loaded direct for Key West.

FOR SALE.

TEMPLE TRANSIT, reading 20" with full attachments. For particulars, address H. E. FLINT, City Engineer's Office, Springfield, Mass. 39-1t

New Water-Works, Atlanta, Ga.

Sealed proposals will be received at the Mayor's office in the city of Atlanta, Ga., until 12 o'clock meridian, on the 1st day of October, 1890, for furnishing material and constructing new water-works, approximately as follows:

One horizontal pumping engine, boilers, etc., with capacity of pumping 10 million gallons in 24 hours against a head of 235 feet.

One horizontal pumping engine, boilers, etc., with capacity of pumping 6 million gallons in 24 hours, against a head of 350 feet.

One filter plant of a capacity of filtering by gravity under a head of 20 feet, 3 million gallons in 24 hours.

Two engine houses and 2 smoke stacks.

One reservoir—69,000 cubic yards of earth excavation, 1,000 yards rock excavation, 10,000 brick laid, 50 cubic yards concrete.

One clear water basin—3,500 cubic yards earth excavation, 500 cubic yards of rock excavation, 450,000 brick laid, 400 square feet concrete.

Pumping well and intake—3,000 cubic yards of earth excavation, 1,000 cubic yards rock excavation, 200,000 brick laid and 100 cubic yards concrete.

Cast iron pipe and specials—
600 lineal feet of 36-inch pipe.
28,000 lineal feet of 30-inch pipe.
7,500 lineal feet of 20-inch pipe.
Valves, tees, crosses, valve boxes, etc.

Two pumping stations, consisting of 2 engine and 2 boiler rooms, one pumping well, one clear water basin and two brick chimneys.

Pipe laying—600 feet of 36-inch pipe, 28,000 feet of 30-inch pipe, 7,500 feet of 20-inch pipe, including valves, valve boxes and specials.

The above quantities and dimensions are to be considered approximate only, the committee reserving the right to increase or diminish as they may elect after receiving bids. Bids will be received for the whole or any particular branch or sub-division of the work.

Specifications and general plans can be seen at the office of the City Engineer or Superintendent of Water-works, Atlanta, Ga.

A certified check for $1,000 must accompany each bid, payable to John T. Glenn, Mayor, to be forfeited in the event of award and a failure to contract within 10 days. The right is reserved to reject any or all bids.

JNO. T. GLENN, Mayor.
R. M. CLAYTON, City Engr.
WM. G. RICHARDS, Supt. W. Wks.
36-4t

Earth Work Slips and Subsidences upon Public Works, their causes, prevention and reparation. Especially written to assist those engaged in the construction or maintenance of Railways, Ditches, Canals, Roads, Water-Works, River Banks, Reclamations, Embankments, etc., etc. By John Newman, 12mo, cloth. London, 1890. $3.00.

For sale by ENGINEERING NEWS PUB. CO.

WANTS.

50 Cts. 50 Cts

Cards of not more than one-half inch will be inserted in this column one time for 50 cents.

SITUATIONS WANTED.

WANTED.—An engineer who expects soon to finish his present engagement desires position on location, construction or maintenance of way. Twenty years experience; 40 years old. Address C. E., Engineering News. 36—

WANTED.—An engineer of 20 years' practic experience on railroads in many States of the Union is open to an engagement. Will accept a position on location, construction, maintenance of way, or with a good contracting firm. Have had much experience in both location and heavy construction. Have instruments of my own. Permanent position more an object than salary. Best of references can be given. Will be glad to confer with parties needing the services of an engineer. Address CIVIL ENGINEER, Box 22, Charlestown, Jefferson Co., W. Va. 36-4t

WANTED.—A graduated civil engineer desires a position as assistant engineer or assistant superintendent with some manufacturing concern in or near New York. Railway equipment line preferred. Has had two years' experience in this line. G., care of Engineering News. 37-3t

WANTED.—A graduate, Civil Engineer and Architect, German, of 20 years' experience (of which nine years has been in America) of railroad location and construction; also in stone and iron bridges and trestles, and buildings; a first-class draughtsman, good letterer; desires position as division engineer, or take charge of party or location. First-class references. Address RAILROAD ENGINEER, care of Engineering News. 38-2t

WANTED.—Engineer, Draughtsman and Surveyor desires a change of position (reasons given). Have had charge of a field and office force. Experience on railroad, city, sewer, hydraulic engineering, cable road work in detail, steam boiler and engine plant and structural iron design. Surveying, topographical and mechanical draughting. Particulars given. Will accept only such position as can fill satisfactory. Address F., 208 East 118th street, New York City. 38-3t

WANTED.—To CAPITALISTS AND INVESTORS—A civil engineer of experience in the location, construction, equipment, and operation of railways wants an engagement with capitalists in developing NEW RAILWAY LINES. Will furnish first-class references. Address E. W., care of Engineering News. 38-8t

WANTED.—Position by a young civil engineer with four years' experience in bridge superstructure, also three years' practical experience on United States Coast and Geodetic Survey, also testing minerals and mining work; good references. Address JAMES A. KELLEY, No. 158 Newell St., Syracuse, N. Y. 39-1t

WANTED.—Position as bridge draughtsman by one familiar with best shop work; over four years' experience; reference given; state salary. Address "POSTAL," Engineering News. 39-1t

WANTED.—A young man desires a position as transitman, and will furnish a first-class transit and can give good references. Address "X," care of Engineering News. 39-1t

WANTED.—An engineer of twenty years' experience in charge of railroad work, both in the construction and operating departments, will be open to an engagement shortly. Address "Y. Z.," office Engineering News. 39-3t

WANTED.—A civil engineer of 10 years' experience on work of various description desires an engagement. Resident engineer on canal and factory construction in the Southern States; also in charge of party on city work, etc. Address "ENGINEER," 128 North Los Angeles St., Los Angeles, Cal. 39-3t

Wanted---A Railroad Man.

A prominent manufacturing company desires to secure the services of a thorough business man who is now or has been identified in an official capacity with some good road. A man having filled the position of General Superintendent or General Manager preferred. To a satisfactory party with some means an official position will be given. Address W. G. & A. T. Ewing, Room 88, Montauk Block, Chicago. 38-4t

PORTLAND CEMENT PIPE CO.,

MANUFACTURERS OF

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